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Gaining Experience as Principal or Agent. An Experimental Study*

Giovanni Ponti, Marcello Sartarelli, Iryna Sikora and Vita Zhukova**

Abstract

We study experimentally whether decisions in a principal-agent model differ when subjects gain experience by changing roles rather being in a fixed role over time. In addition, we examine whether increasing principals' profit opportunities has an impact on their decisions. To this aim, we use a stylised labour market where multiple principals compete to hire teams of two agents by offering wage contracts and claiming residual profits after paying agents. Players' *roles*, either *assigned randomly* every round or *fixed*, and principals' *profit opportunities*, either *high* or *low*, vary in a between-subject design. We find that both changing roles and facing high profit opportunities leads principals to offer more frequently efficient contracts in inducing both agents to put effort and to higher payoffs for everyone, with some complementarity between role changes and profit opportunities.

Keywords: direct-response method, experience, fixed role, laboratory experiment, principal-agent, profit opportunities, role change, stakes size

JEL classification numbers: C91, C92, D8, J41.

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1 Introduction

Experience has been shown to have an important role in explaining differences in workers' and firms' productivity, for example, in wage regressions in non-experimental settings. Similarly, recent experimental evidence from the field shows that experience matters in a variety of contexts, e.g. it increases the probability of callbacks after sending CVs for a job (Bertrand and Mullainathan, 2004) and it reduces the endowment effect in trading sportscards (List, 2003). However, the commonly used measure of experience, both theoretically and empirically fails to account for experience in different roles. This is the motivation behind early laboratory experiments, in which subjects gained experience either only in one or in both roles in the ultimatum game. The evidence is somewhat mixed as some studies find that proposers' offers are closer to the zero equilibrium level when playing different roles while others find the opposite (see Brandts and Charness, 2011, for a review).

In the lab using a principal-agent model, the impact of experience in a single role rather than in both has not been studied although this is a setting which characterises very well employer-employees interactions in the labour market. Laboratory experiments using a principal-agent model have, instead, focused on the importance of information asymmetry and individual heterogeneity in explaining principals' decisions over wage offers to agents, with subjects' roles being fixed (*e.g.*, Cabrales *et al.*, 2010; Fehr and Schmidt, 2004; Fehr *et al.*, 2013; Hoppe and Schmitz, 2013). Hence, in this paper we test whether individuals' exposure to different roles by manipulating it experimentally in a principal-agent model to examine in a repeated interaction setting whether principals' decisions differ when playing different roles rather than the same role over time.

Our interest is motivated by frequently observing in real life situations in which roles as principal or agent are reversed over time. For example, in R&D the scientist leading a project is the one who, in addition to coming up with an innovative idea, has related experience and enough time to bring together a team of specialists for its completion. In a different project, instead, the same individual may act as an expert while somebody else leads the project, with evidence on principal investigators (PIs) in the US showing that scientists, on the one hand, value the benefits of being PI while, on the other, they may decide to let a colleague lead as PI due to sometime very time-consuming duties of an administrative and managerial nature for PIs (Corneli *et al.*, 2017; Cunningham *et al.*, 2014).[1]

We also define principals' *profit opportunities* as the expected profit conditional on agents' effort and manipulate them to test, first, whether the agency theory canonical prediction holds, namely that a principal's decision depends only on the agent's participation and incentive-compatibility constraint, as the effect of stakes is, ultimately, an empirical question. We believe that studying the role of stakes size in our setting contributes to the experimental literature as evidence on the effect of stakes in different settings seems to be mixed (see Camerer and Hogarth, 1999; Karagözoğlu and Urhan, 2017, for recent reviews) while non-experimental evidence shows that changes in profit opportunities across firms, sectors, countries or over time are associated with different corporate decisions on, for example, the capital and labour mix (Bartelsman and Doms, 2000; Baily and Solow, 2001). Second, we test whether the stakes size effect is independent from the role change effect on principals' decisions or, instead, the effects are complements or substitutes, i.e., higher profit opportunities amplify or reduce respectively the effect of role change on, for example, the efficiency of principals' decisions. This is motivated by frequent role changes being ubiquitous in the corporate hierarchy, which may affect corporate decisions and with heterogeneity depending on stakes size.

To this aim, we borrow the basic experimental layout of a stylized labour market with multiple principals and agents from Cabrales *et al.* (2010), in which principals compete to hire teams of two agents by offering them wage contracts in the form of 2x2 effort games. Among different contracts that can be offered by principals, efficient ones are those that induce both agents to exert effort. Subjects have fixed roles which are selected randomly at the beginning of the experiment and are unchanged over the 24 rounds in each experimental session.

We depart from the original experimental design by varying subjects' role and principals' profit opportunities in a 2x2 between-subject design. In addition to the *fixed role* treatment, we run the *random role* treatment, in which principals

[1]Similarly, in the movie industry, competitive pressure for low-cost productions seems to have blurred distinctions between roles as manager, writer or actor, with the same individual playing different roles over time (Christopherson, 2008).

are selected randomly at the beginning of each round and all subjects know the role actually played before decisions in the role played are taken, i.e. we use the direct-response method. To increase profit opportunities relative to the original experimental design, we increased revenues in principals' profit function, being on average 30% higher in the *high profit* relative to the *low profit* opportunity treatment.

We find that both changing roles and increasing profit opportunities leads principals to choose, among different contracts available, the efficient one more frequently. This leads agents to exert effort more frequently and to higher payoffs for everyone. We also find a degree of complementarity between our treatments with, for example, high profit opportunities amplifying the magnitude of the random roles effect in inducing principals to offer the efficient contract. Overall, our results contribute to the experimental literature by showing for the first time for the principal-agent model that accumulating experience by changing roles leads to observe more frequently efficient decisions by principals and agents. In addition, by showing that principals' profit opportunities matter, we contribute to the literature that has found mixed results, for example, in the ultimatum game, by suggesting that the agency theory canonical prediction, namely that a principal's decision depends only on the agent's participation and incentive-compatibility constraint, does not seem to hold in our setting.

The remainder of this paper is as follows. Section 2 reviews the related literature. Section 3 describes the experimental design. Section 4 describes the results of our empirical analysis and Section 5 discusses them. This is followed by an Appendix with further empirical evidence and a copy of the instructions.

2 Literature review

The experimental literature has provided evidence on differences in individuals' decisions when playing one or both roles by using two experimental methods to obtain information on subjects' decisions in different roles. The pioneering study of Güth *et al.* (1982) investigates in the ultimatum game differences in individuals' decisions when playing the same role rather when playing both the proposer and the receiver role by using the strategy method, i.e. subjects take decisions under different roles before knowing which role they will actually play. The results of this study show that proposers' offers when playing both roles are higher than when playing only one role. The same experimental design was implemented in the lab by Binmore *et al.* (1985) but using, instead, the direct-response method, i.e., after taking their decisions receivers were invited later on to participate also as proposers. They find that proposers playing both roles make less generous offers than those who only played as proposers, which differs from results in Güth *et al.* (1982) and it is more in line with a proposer's zero offer equilibrium.

Burks *et al.* (2003) test the impact of role reversal by replicating the trust game of Berg *et al.* (1995) as a baseline treatment and proposing two alternative information treatments. In one treatment, subjects are informed only after playing one role that they will play again with roles reversed. In the other, they are informed before starting the experiment that they will play both roles. They find that when subjects are informed before the experiment about role reversal individuals' trust and reciprocity are lower than in the baseline game where subject play only one role. The authors try to rarionalise this result by using evidence from subjects' questionnaires which shows that under role reversal subjects feel less responsible about the subject they are matched who will have additional opportunities and in different roles to gain money in the game. In related work, Espín *et al.* (2016) allow individuals to play both roles over time to test the relationship between amounts sent and returned. In a setting in which individuals know the outcomes of their decisions before changing role, they find a positive correlation between giving in different roles.

The dictator game has been exploited to examine individuals' decisions with and without role uncertainty. This method is a variant of role reversal in which subjects play both roles, as in role reversal, except that only their decision in one of the two roles played will be selected randomly and implemented. Iriberri and Rey-Biel (2011) use subjects' decisions in the game to define them as either altruistic, selfish or spiteful to then study whether the percentage of subjects by type is unchanged under role uncertainty, using a between-subject design. They find that under role uncertainty altruistic subjects are over-represented and selfish ones under-represented relative to the baseline without role uncertainty and conclude by warning experimenters that using role uncertainty to elicit other-regarding preferences may lead to biased results.[2]

Overall, our paper contributes to experimental studies assessing the impact of role changes on subjects' decisions by proposing a novel combination of existing methods and designs to examine the extent to which the efficiency of principals' decisions is explained by whether a principal has been exposed to also taking decisions as agent and vice versa, as we believe that it is a stylised characterisation of a frequently observed phenomenon in the labour market.

As for the importance of profit opportunities in principals' decisions, the experimental literature has studied the impact of stakes size on subjects' decisions, by varying their payoffs by as much as 1000 times relative to the baseline value in a variety of settings. However, the evidence is somewhat mixed (see Camerer and Hogarth, 1999; Karagözoğlu and Urhan, 2017, for recent reviews). Perhaps the main takeaway is that the existence of financial incentives tends to matter while the effect of varying their magnitude is less clear-cut. In line with theoretical predictions, changes in stakes do not significantly affect subjects' offers, for example, in dictator and ultimatum games (e.g. Carpenter *et al.*, 2005; Cherry *et al.*, 2002; Fehr *et al.*, 2014). In contrast, the proportion offered decreases with stakes in a trust game experiment in Bangladesh in which stakes are increased by up to 25 times (Johansson-Stenman *et al.*, 2005). Similar results are obtained in an ultimatum game experiment in India with stakes of up to 1000 times (Andersen *et al.*, 2011). However, in this experiment the amount offered increased and the rejection rate decreased with stakes.

To the best of our knowledge, only two experimental studies look at the joint role of experience in difference roles and of financial stakes. Slonim and Roth (1998) increase stakes in an ultimatum game by up to 25 times in a between-subjects design while experience is studied by exploiting subjects' repeated decisions over time. They find that stakes have no impact on offers for inexperienced subjects while offers tend to decrease more slowly as subjects gain experience. In addition, they find that rejection rates decrease with experience. In a different setting, the centipede game, Parco *et al.* (2002) show that increasing stakes 100 times significantly increases the

[2]See Brandts and Charness (2011) for a survey comparing and contrasting laboratory experiments implemented using direct-response and strategy methods, with the main finding being that the results of a given experiment seem to depend little on the method used.

probability of ending the game either at the first or at an early decision node, in line with predictions.

In this line, we contribute to the literature studying the role of stakes on decisions by showing experimental evidence that even a small increase in profit opportunities, by 30% on average, for principals in a principal-agent model and no change in agents' stakes, induces principals to offer more efficient contracts. Similarly, we show that a small increase in stakes leads to some complementarity with role change, in increasing the efficiency of principals' decisions. This result speaks to the literature studying the role of stakes size by suggesting the existence of a perhaps under-explored relationship between stakes and experience in one or in different roles.

3 Experimental design

We recruited at the Universidad de Alicante, by using ORSEE (Greiner, 2004), 192 undergraduate students to participate in one of the 8 experimental sessions, each with 24 subjects, that we ran in the Laboratory for Theoretical and Experimental Economics (LaTEx). Each session was computerized using z-Tree (Fischbacher, 2007). The 24 subjects in each session are randomly assigned to one of two cohorts of 12 subjects at the beginning of the session, with subjects from different cohorts never interacting with each other across the entire experiment.[3]

The basic design layout to study the role of experience in different roles and of profit opportunities in the interaction between multiple principals and agents in a stylized labour market was borrowed from Cabrales *et al.* (2010) and develops in three consecutive phases, with each of them consisting of 24 identical rounds.[4]

3.1 Phase 1 and 2

In *Phase 1*, the 24 subjects are firstly randomly matched with a partner to form 12 pairs in each of its 24 rounds. An additional random draw assigns subjects in each

[3]Participants gave their consent to participate in social experiments when they signed up in ORSEE (Greiner, 2004), the online recruitment tool used at LaTEx.

[4]Before starting each phase, we handed out to the participants the instructions for that phase, we read them aloud and then asked if they had any clarifying questions. A copy of the instructions, translated from the original ones in Spanish, is shown in Appendix B. We made sure that our instructions are neutrally worded by using the word "referee" and "player" for principal and agent respectively to avoid connotations induced by the choice of words that might affect subjects' decisions.

pair to a role as player 1 or 2. Then each player has to choose one among four possible options $C_t = \{b_t^k\}, k = 1, ..., 4$. Each option $b_t^k \equiv (b_{1t}^k, b_{2t}^k)$, with $b_{1t}^k \geq b_{2t}^k$, constitutes a payoff pair for player 1 and 2 and determines the payoffs received by players in a Random Dictator Game-Type protocol (Harrison and McDaniel, 2008), with the dictator's identity being randomly assigned in each round after both players in a pair have taken their decisions. We use evidence from Phase 1 to estimate subjects' purely distributional preference parameters within the realm of the classic Fehr and Schmidt (1999) model of distributional preferences. Estimated parameters are then used as controls in our empirical analysis.

In *Phase 2*, subjects are again randomly matched in pairs each round, as in Phase 1. This phase consists of two stages. In Stage 1, each subject in the pair has to choose among four possible options, similarly to Phase 1. However, this time each option k determines a 2x2 effort game $G(k)$ played simultaneously by players $i = 1, 2$, who choose a binary effort level δ_i, which is interpretable as the wage bill of a contract as it depends on the joint effort of players in a pair.

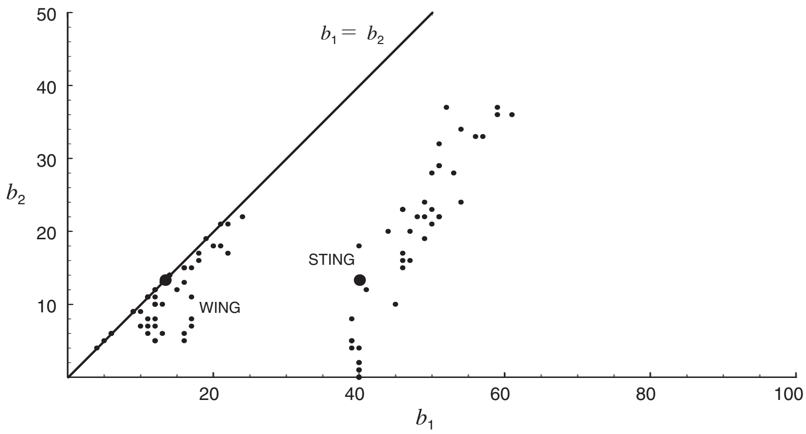
$$\pi_{it}^k = B + P(\delta)b_{it}^k - \delta_1 c \quad (1)$$

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

By letting $\delta = (\delta_1, \delta_2)$ be players' strategy profile, player i's payoff π_{it}^k for choosing option k at time t is given in equation (1). $B = 40$ is a fixed component not depending on effort while b_{it}^k depends on effort by player i and by the player (s)he is paired with. Player i obtains the full payoff b_{it}^k if both players put effort, only a fraction $\gamma = 1/4$ of the full payoff if only one player puts effort and 0 if no player puts effort, as shown in equation (2). The cost incurred by player i for putting effort is $c = 10$. A random draw fixes the identity of the dictator, whose choice determines the effort game k to be played in Stage 2. Data from Phase 2 are also used as controls in our empirical analysis.

Payoffs in Phase 1 and 2 are obtained in Cabrales *et al.* (2010) as solutions of two mechanism design problems aimed to induce subjects to put effort in Phase 2, while payoffs in each option in Phase 1 are those associated to the full effort profile of the corresponding game in Phase 2. In one solution, called *Weakly effort-INducinG* (WING), an agent has a strict incentive to put effort only if the other does. This implies that in the resulting 2x2 effort game no effort by either agent is a Nash equilibrium.[5]

Figure 1: Contract payoffs



In the other solution, called *STrongly effort-INducinG* (STING), agent 1 has a strict incentive to put effort independently of what the other does while agent 2 has a strict incentive to put effort only if agent 1 does, as under WING. In these contracts, in which inequality in payoffs between agents in a pair, i.e. $b_1 > b_2$, is on average higher than under WING, the all-effort profile is the unique Nash equilibrium and they are defined as "efficient" in fully exploiting the strategic complementarities in terms of agents' effort (Winter, 2001).

Figure 1, which shows a graph with b_1 measured on the horizontal axis and b_2 on the vertical one, is borrowed from Cabrales *et al.* (2010) to illustrate the difference in payoffs between WING and STING contracts. In the menu of 4 contracts shown to subjects, from which they choose one, contracts can be either all WING, all STING or 2 WING and 2 STING. We used the same sequence of WING, STING and mixed contracts over different experimental rounds as in the design in Cabrales *et al.* (2010) in all the experimental sessions. An illustration of WING and STING contracts is given using our experimental user interface in the following subsection,

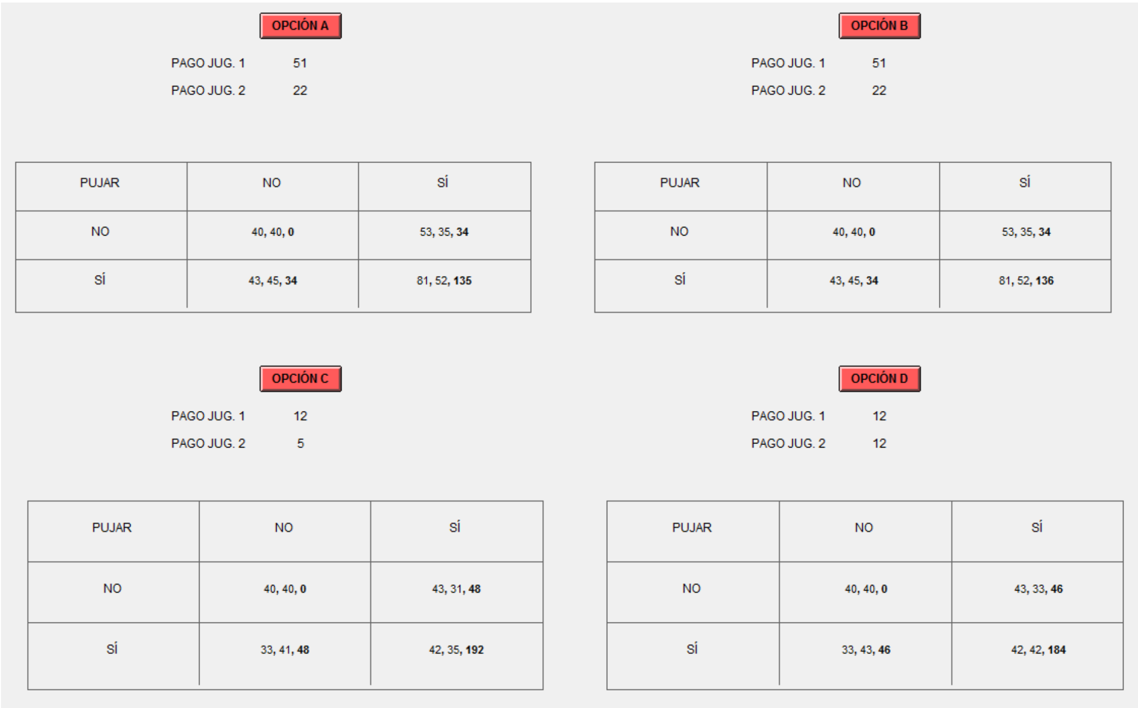
[5]Additional details about the derivation of agents' payoffs can be found in Appendix A in Cabrales *et al.* (2010).

when we discuss the set of contracts shown to principals in Phase 3.[6]

3.2 Phase 3

Subjects in a session are randomly divided into 8 principals and 16 agents, with 4 principals and 8 agents per cohort. Then, each principal chooses a contract from the menu of 4 contracts that is presented on their screens, labeled from A to D, as shown in Figure 2. Each of the 4 cells in a contract shows 3 payoffs from left to right: the first two are respectively for agent 1 and agent 2 in a pair and the third, that is shown in bold, is for the principal.

Figure 2: Phase 3 user interface: principals' contracts menu



Each principal offers a contract, i.e., a 2x2 effort game with the same characteristics of those played in Phase 2, selected from the round choice set. Figure 2 illustrates the round choice set for principals in rounds with 2 WING contracts, options C and D, and 2 STING contracts, options A and B. The presence of several competing principals acts as a menu of contracts among which agents may sort themselves by choosing a contract offered by principals.

The 8 agents in each cohort are randomly matched at the beginning of each round, as in Phase 1 or 2. In addition, a random draw decides who is the better

[6]User interfaces for Phase 1 and 2 can be found in Figure A.1 and A.2 in Appendix A.

paid one in each pair, i.e., agent 1. Once the 4 principals in a cohort have chosen a contract each, the 4 contracts chosen are offered to each pair of agents. Once all agents have chosen a contract, a random draw between the 2 contracts chosen in each pair by agents determines which contract is implemented within the pair. Finally, once the contracts to implement are decided, each agent chooses whether to put effort in the game induced by the ruling contract.

Principals' profit for choosing option k is the difference between revenues V, which are identical for all principals, and the contract cost $b_1 + b_2$ that is incurred to pay those pairs of agents who chose option k, as shown in equation (3). $P(\delta)$, which multiplies principals' profit function, is taken from equation (2) and indicates that principals obtain no profit from a pair of agents if no agent puts effort, a quarter of the full profit if only one agent puts effort and the full profit if both put effort. Agents' payoffs, as in Phase 2, are given by equation (1).

$$\pi_0 = P(\delta)[V - (b_1 + b_2)] \tag{3}$$

The profit that is generated through agents' effort is all accrued to the same principal if more than one pair of agents has chosen the same contract. If more than one principal offered the same contract, instead, the profits generated by the agents choosing that contract are shared among all principals who offered it.

3.3 Treatments

Subjects' roles and principals' profit opportunities were varied using a 2x2 between subjects design, as illustrated in Table 1. Out of our 8 experimental sessions, in 2 sessions subjects have fixed roles and principals face low profit opportunities (FixRole & LowProf); in 2 sessions roles are randomly assigned every round and principals have low profit opportunities (RanRole & LowProf). In 2 additional sessions roles are fixed and principals have high profit opportunities (FixRole & HighProf) while in the remaining 2 sessions, roles are randomly assigned and principals have high profit opportunities (RanRole & HighProf).

Roles are fixed in sessions in which principals were selected randomly among subjects in round 1 and their role was unchanged for the 24 rounds in a session. Roles

Table 1: Experimental design illustration

		Profit opportunities	
		Low	High
Role	Fixed	FixRole & LowProf	FixRole & HighProf
	Random	RanRole & LowProf	RanRole & HighProf

were, instead, changed in sessions in which subjects were randomly assigned to either role at the beginning of each of the 24 rounds in a session. In a cohort consisting of 4 principals and 8 agents, any subject could be principal with probability 1/3 and agent with probability 2/3, or on average for 8 and 16 periods respectively out of the 24 periods in a session. As for *profit opportunities*, they are low when revenues are drawn from a uniform distribution in the interval $[150, 225]$ and, instead, high when revenues are drawn from the interval $[200, 300]$, i.e., on average 30% higher.

3.4 Payment

Payoffs including all three phases in the experiment are about 20 euros and a full experimental session lasted approximately 90 minutes. Average payoffs from the stylized labour market, i.e., Phase 3, are about 6 euros, with this phase lasting approximately 30 minutes. Information on payoffs per round in a phase was shown on-screen and the cumulative payoff was shown at its end. Spanish peseta was used as experimental currency. The exchange rate is 100 pesetas for 0.601 euros, which is still commonly known in Spain, where it was shown, for example, in supermarkets alongside the price in euros at the time experiments were conducted.

4 Results

This section begins by defining measures for the principals' contract choices that we use in our empirical analysis (section 4.1). Subsequently, we report differences in our outcomes of interest by pooling data at the treatment level (section 4.2). Finally, we report panel data regression estimates of individuals' decisions to fully quantify the separate as well as the joint role of experience in different roles and of profit opportunities thanks to the longitudinal dimension of our data, as each experimental session consists of 24 identical rounds (section 4.3).

4.1 Contract choice measures

We define two variables, borrowed from Cabrales *et al.* (2010), to describe the main characteristics of the contracts that principals offer agents, in the form of the 2x2 effort games: *relative inequality* and *relative cost* in contract $\bar{k}$ with respect to the other contracts available. To compute the *relative inequality* in a contract $\bar{k}$ we first define inequality, i.e., $b_1^{\bar{k}} - b_2^{\bar{k}}$, and the minimum and the maximum inequality among available contracts, *i.e.* $\min_k(b_1^k - b_2^k)$ and $\max_k(b_1^k - b_2^k)$ respectively. Then, the *relative inequality* in a contract $\bar{k}$ with respect to other contracts available is the ratio between *i)* the difference between inequality in the contract and the minimum inequality among available contracts, i.e., $(b_1^{\bar{k}} - b_2^{\bar{k}}) - \min_k(b_1^k - b_2^k)$ and *ii)* the whole range of inequality among available contracts, i.e., $\max_k(b_1^k - b_2^k) - \min_k(b_1^k - b_2^k)$, as shown in equation (4).

$$\text{Relative inequality} = \frac{(b_1^{\bar{k}} - b_2^{\bar{k}}) - \min_k(b_1^k - b_2^k)}{\max_k(b_1^k - b_2^k) - \min_k(b_1^k - b_2^k)}, \quad k = 1, ..., 4 \tag{4}$$

Similarly, we compute the *relative cost* in a contract $\bar{k}$ by first defining cost, i.e., $b_1^{\bar{k}} + b_2^{\bar{k}}$ and the minimum and the maximum cost among available contracts, i.e., $\min_k(b_1^k + b_2^k)$ and $\max_k(b_1^k + b_2^k)$ respectively. Then, the *relative cost* in a contract $\bar{k}$ with respect to other contracts available is the ratio between *i)* the difference between the contract cost and the minimum cost among available contracts, i.e., $(b_1^{\bar{k}} + b_2^{\bar{k}}) - \min_k(b_1^k + b_2^k)$ and *ii)* the whole range of cost among available contracts, i.e., $\max_k(b_1^k + b_2^k) - \min_k(b_1^k + b_2^k)$, as shown in equation (5).

$$\text{Relative cost} = \frac{(b_1^{\bar{k}} + b_2^{\bar{k}}) - \min_k(b_1^k + b_2^k)}{\max_k(b_1^k + b_2^k) - \min_k(b_1^k + b_2^k)}, \quad k = 1, ..., 4 \tag{5}$$

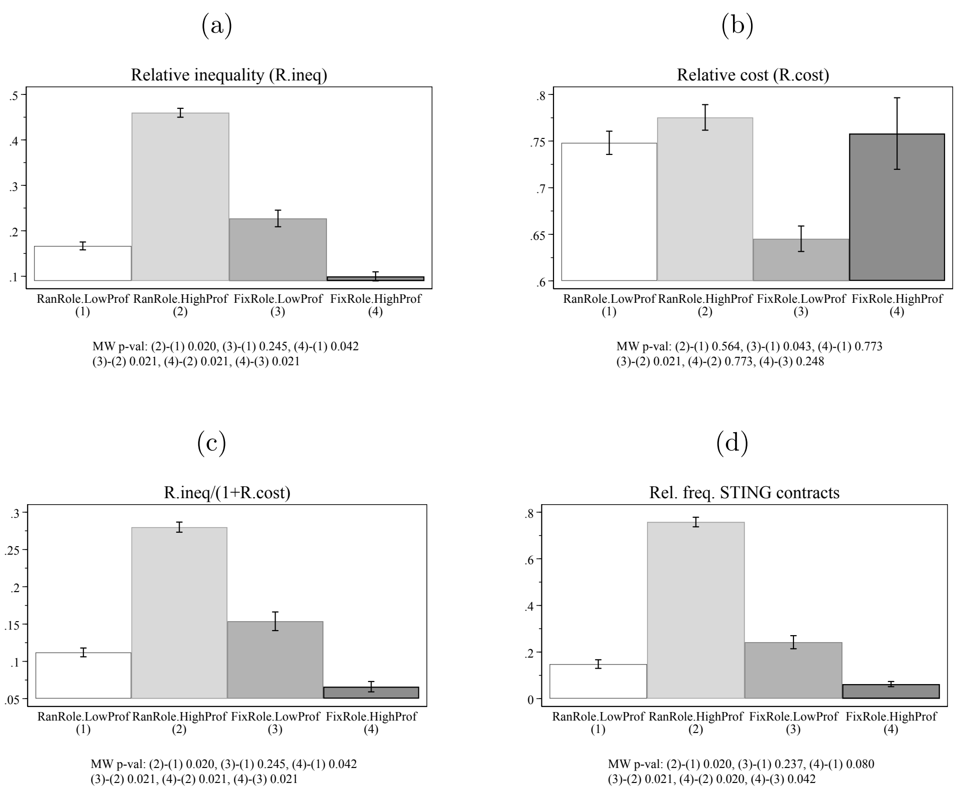
To compare the inequality in payoffs for agents in a team chosen by principals paying a similar total cost for the teams' effort, we also compute the ratio between relative inequality and the sum between 1 and relative cost, denoted by *Relative inequality/(1+ relative cost)*.[7]

[7] We added 1 to the relative cost in the denominator to avoid indeterminate values if the relative cost in the denominator is close to zero.

4.2 Pooled data analysis

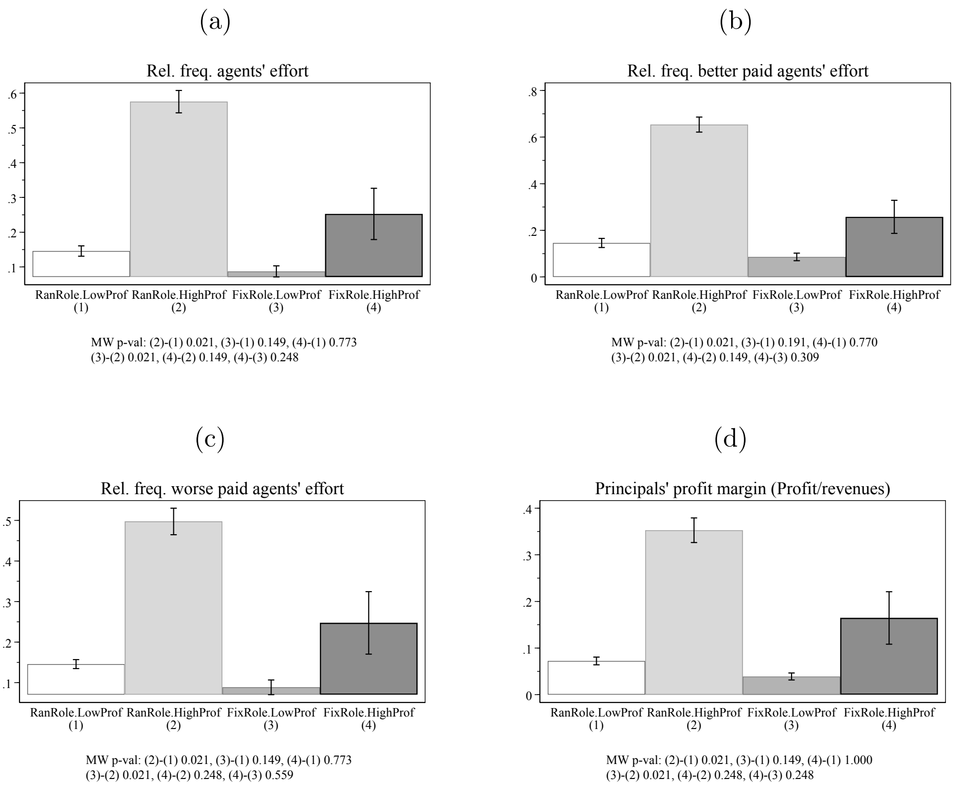
We begin by comparing principals' contract choices across treatments by using pooled data at the treatment level and reporting in Figure 3 Mann and Whitney (1947) p-values of differences across treatments (abbreviated MW p-val in Figure 3). Panel (a) shows that the relative contract inequality is significantly higher under the random role when profit opportunities are high relative to when they are low (p=0.020) and, in addition, relative to the fixed role treatment when profit opportunities are either high (p=0.021) or low (p=0.021). When we look at panel (b) of Figure 3, we observe that the relative contract cost is significantly higher under the random relative to the fixed role treatment when profit opportunities are low (p=0.043) and, in addition, under random roles and high profit opportunities relative to fixed role and low profit opportunities (p=0.021).

Figure 3: Principals' contract choice



When we jointly account for relative inequality and cost in contract choices, panel (c) in Figure 3 shows that the ratio between relative inequality and relative cost is highest under random roles and high profit opportunities and differences relative to other treatments are very similar in magnitude and in precision to the differences in relative inequality in panel (a). Finally, panel (d) of Figure 3 shows a similar pattern also for the relative frequency of choosing efficient contracts, *i.e.* STING contracts, in rounds in which principals can choose between STING and WING contracts. It is significantly higher for random roles and high profit opportunities relative to all other treatments (p=0.02) and, in addition, under fixed roles it is significantly higher under low relative to high profit opportunities (p=0.042).[8]

Figure 4: Agents' effort and principals' profit



When we look at agents' decisions in Figure 4, we find that their effort in the 2x2 effort games determined by the ruling contract is significantly higher under random roles with high profit opportunities compared to both random and fixed roles with low profit opportunities (p≈0.02). This holds when we consider efforts by all agents and also when we consider better and worse paid agents separately, i.e. player 1 and 2 respectively, as shown by panels (a)-(c) in Figure 4. In addition, we find the same results when we look at the ratio between profit and revenues for principals in

[8]We use the Mann and Whitney (1947) test to assess the significance of differences in non-normally distributed variables in small samples, since in our 2x2 between subject experimental design there are 4 individual independent observation per treatment (2 independent cohorts per session and 2 sessions per treatment). Standard error bars reported in Figure 3 and 4 are purely descriptive.

panel (d) in Figure 4. We use this measure, which is interpretable as profit margin for the principal, to allow comparability between low and high profit opportunities treatments as in the latter profits are mechanically higher due to revenues being varied experimentally in one of our treatments.

4.3 Regression analysis

In what follows we estimate a random-effects panel regression model of subjects' decisions over our 24 identical experimental rounds to quantify to the size of our experimental treatments and whether they are independent, complements or substitutes in influencing principals' and agents' decisions. The additional advantage of panel regressions is assessing the robustness of the results described in the previous section to absorbing the variation in behavior for the same subject across different experimental rounds, i.e., within-subject. In all estimates that we report standard errors are clustered at cohort and session level to account for heterogeneity between cohorts.

$$Y_{i,t} = \beta_0 + \beta_1 RanRole + \beta_2 HighProf + \beta_3 RanRole * HighProf + u_{i,t} \quad (6)$$

In equation (6), Y is one of our outcomes of interest and the explanatory variables are dummies for our experimental treatments. $RanRole$ is equal to 1 for subjects in sessions in which they changed roles over time in our block design and 0 if their roles were fixed over time while $HighProf$ is equal to 1 for subjects in sessions in which principals had high profit opportunities and 0 for principals with low profit opportunities. The marginal effect of our experimental treatments are the coefficients associated to our treatment dummies in models with no interaction term between our treatments. When we, instead, introduce in the regression the interaction term to test for the presence of complementarity or substitutability between our treatments, we will compute marginal effects separately. The constant term captures the effect of the baseline treatment with fixed roles across experimental rounds ($RanRole = 0$) and low profit opportunities for principals ($HighProf = 0$).

Table 2 reports linear panel estimates obtained using as outcomes proxies for the type of contract principals offered agents and for the profit obtained by principals',

Table 2: Principals' decisions and profits (linear panel model)

	(1)	(2)	(3)	(4)	(5)	(6)
	Rel. ineq./(1+rel. cost)		Efficient contract		Profit/revenues	
RanRole (RR)	0.085**	-0.042*	0.294***	-0.099*	0.110*	0.033*
	(0.037)	(0.025)	(0.114)	(0.060)	(0.060)	(0.020)
HighProf (HP)	0.074**	-0.088***	0.345***	-0.180***	0.234***	0.126
	(0.033)	(0.026)	(0.099)	(0.054)	(0.048)	(0.102)
RR*HP		0.254***		0.791***		0.155
		(0.030)		(0.073)		(0.112)
Constant	0.073**	0.154***	-0.020	0.242***	-0.015	0.039***
	(0.037)	(0.022)	(0.113)	(0.050)	(0.045)	(0.013)
N	1,536	1,536	512	512	1,536	1,536
MFX RR=RR+0.5RR*HP		0.085***		0.296***		0.111*
		(0.015)		(0.036)		(0.056)
MFX HP=HP+0.5RR*HP		0.039**		0.216***		0.203***
		(0.015)		(0.036)		(0.056)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses

which depends on the number of agents who worked for a given principal and on agents' effort decisions. Column (1) shows that both the effect of the random role ($RanRole$) treatment and of the high profit opportunity treatment ($HighProf$) lead to a significantly higher ratio between inequality in the contract offered and relative cost of the contract. In column (2) we obtained estimates of a model in which, in addition to our treatments dummies, we also introduced the interaction term between them (RR*HP). The positive and significant estimated coefficient of the interaction term indicates some degree of complementarity between our treatments. While in column (1) the estimated coefficients associated to our treatments are readily interpretable as marginal effects, in column (2) they are not. Hence, we computed marginal effects (MFX) at the mean value for each treatment, which is 0.5 since both experimental treatments are binary, and report them in the same column in the bottom panel of Table 2. When we compare the coefficients from the two models, in column (1) and (2) respectively, we find that the sign and significance of role change and the profit opportunities effects are the same.[9]

When we look at the effect of our treatments on the probability that a principal offers a STING, i.e., efficient contract in those experimental rounds in which WING contracts are also available in the round choice set, we find that both treatments

[9]We do not report estimates of the effect of our treatments on relative inequality as they are similar to those for the ratio between relative inequality and relative cost, which we prefer as it offers a measure of inequality for contracts with similar cost. However, they are available upon request.

have a positive and significant effect, as shown in columns (3) and (4) in Table 2, and exhibit some complementarity, as shown by the positive and significant coefficient of the interaction term. This indicates that the higher inequality in principals' contract choice we observe in columns (1) and (2) is due to the more frequent choice of STING contracts, whose payoffs for player 1 and 2 exhibit on average higher inequality relative to WING contracts. Finally, when we look at principals' profit margin in columns (5) and (6) in Table 2, we find that they are only weakly significantly higher under the random role treatment, they are significantly higher under the high profit opportunities treatment and show no significant complementarity effect.[10]

While we reported linear panel estimates in Table 2 to make the description of our results easily understandable, our results are robust to using the following panel two models: first, a Tobit model to account for censoring in the ratio between relative inequality and relative cost of contracts offered by principals, as well as in the profit margin, as shown in Figure A.3 in Appendix A; second, a Logit or Probit panel model to account for non-linearities in the relationship between the "Efficient contract" dummy and our experimental treatment dummies. These results can be found in Table 2 in Appendix A.

Table 3 reports Logit panel estimates obtained using as outcomes proxies for agents' binary effort, with estimates obtained without the interaction term between our treatment dummies and with it, as in Table 2. Columns (1) and (2) show that both the effect of the random role treatment and of the high profit opportunity treatment lead to a significantly higher probability that all agents choose to exert effort in the 2x2 effort game, with some complementarity between treatments, as shown by the positive and significant coefficient of the interaction term. In addition, we report results that look separately at the better and worse paid agents in a pair to assess potential differences in their behavior. Columns (3) and (4) in the table show that results for better paid agents are in line with those for all agents, with both treatments leading to a positive and significant effect and some complemen-

[10]In Table 2 the overall number of observations for panel regressions using data on principals' decisions in all rounds is 1,536. This is obtained by multiplying the 8 principals per experimental round by the 24 rounds per session and the 8 sessions we ran in our experiment. When we, instead focus on the efficient contracts dummy, the number of observations is a third of the total number, i.e., 512, as the round choice set for principals includes WING and STING contracts only in 8 of the 24 experimental rounds, as in the original experimental design.

Table 3: Agents' effort (Logit panel model)

	(1)	(2)	(3)	(4)	(5)	(6)
	All agents		Better paid agents		Worse paid agents	
RanRole (RR)	1.395***	0.596	1.798***	0.675	1.243***	0.570
	(0.327)	(0.477)	(0.351)	(0.507)	(0.383)	(0.575)
HighProf (HP)	2.478***	1.572***	2.726***	1.475***	2.331***	1.592***
	(0.326)	(0.505)	(0.353)	(0.533)	(0.389)	(0.602)
RR*HP		1.445**		1.957***		1.190
		(0.645)		(0.682)		(0.771)
Constant	-3.791***	-3.287***	-3.967***	-3.231***	-3.824***	-3.409***
	(0.323)	(0.377)	(0.365)	(0.409)	(0.397)	(0.461)
N	3,072	3,072	1,536	1,536	1,536	1,536
RR MFX	0.157***	0.179***	0.204***	0.232***	0.132***	0.146***
	(0.035)	(0.036)	(0.036)	(0.037)	(0.039)	(0.040)
HP MFX	0.279***	0.283***	0.310***	0.319***	0.248***	0.249***
	(0.033)	(0.035)	(0.033)	(0.037)	(0.037)	(0.040)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

tarity between them. Finally, columns (5) and (6) show that results are similar for worse paid agents, except for the complementarity between treatments, which is not significant.

We report estimates from a Logit model in Table 3, rather than from a linear model, since the latter set of estimates differ somewhat in significance, as shown in Table A.3 in Appendix A. This may be a result of the assumption of a linear relationship between our experimental treatments and the probability that agents put effort.[11]

Our main results reported in Table 2 and 3 are robust to adding as controls in the regressions subjects' predetermined characteristics: gender, age cognitive ability proxied by the CRT (Frederick, 2005), parents' completed education and proxies for social preferences and for subjects' reciprocity beliefs, as shown in Table A.1 in Appendix A.

[11]In Table 3 the overall number of observations for panel regressions using data on agents' decisions in all rounds is 3,072. This is obtained by multiplying the 16 principals per experimental round by the 24 rounds per session and the 8 sessions we ran in our experiment. When we, instead, focus separately on better and worse paid agents in a pair the number of observations is 1,536 as agents are split evenly between better and worse paid.

5 Discussion

We tested with a laboratory experiment, for the first time in a principal-agent setting, the joint impact of experience in different roles over time to allow subjects to learn the monetary consequences of decisions taken both as principals and as agents, and of profit opportunities for principals on their decisions. Our design is motivated by the non-experimental evidence showing that differences in roles and profit opportunities are associated with different individual-level or corporate decisions, while experimental evidence has mainly looked at their impact separately and results are not conclusive.

Finding in our experiment that the efficiency of contracts chosen by principals, agents' effort and the ensuing payoffs are higher under role change suggests that subjects may consider more carefully the interdependence of decisions taken in different roles and their monetary consequences when they experience themselves the consequences of decisions in different roles. These results speak to the experimental literature that has studied the impact of role change in a variety of settings and with different methods by highlighting the suitability of the principal-agent setting to study in a controlled environment important phenomena observed, for example, in the labour market.

In addition, our result that subjects' decisions are more efficient when stakes for the principal, namely profit opportunities, are higher suggests that the canonical contract theory prediction, according to which a principal should offer the efficient contract independently of whether profits are small or large, as long as they are positive, may not hold in a repeated interaction setting. This suggests to perhaps more carefully account for potentially relevant factors, such as subjects' beliefs or response times, to better understand the nature of the limitation of the canonical prediction. Our results contribute to the literature that has studied the impact of stakes size on decisions mainly in the ultimatum game, with mixed results. They suggest a parsimonious setting in which a modest increase in principals' stakes, by 30% on average, relative to the sizable increase by up to 1000 times observed in ultimatum game experiments, has an impact on principals' decisions.

When we looked at the joint impact of role change and of profit opportunities, we found some complementarity between them. This suggests that the nature of the learning process undertaken by subjects changing roles, about how the interdependence of their decisions affects their monetary payoffs, may somewhat differ depending on the stakes size. We believe that this result is novel since existing experimental studies looked at the role of experience simply by observing subjects' repeated decisions in the same role over time while we are aware of no study varying experimentally both roles and stakes. As for our results on the complementarity between roles change and profit opportunities in contributing to the efficiency of principals' decisions, they are qualitatively in line with stylised facts on the relationship between role interchanges in the corporate hierarchy, profit opportunities and corporate decisions. While, on the one hand, it would be interesting to assess whether non-experimental evidence is in line with our results, on the other, obtaining detailed administrative data for this purpose, particularly on changes in executives' roles over time, poses a challenge.

From a methodological viewpoint, since our results were obtained implementing the direct response method by varying roles randomly over experimental rounds, rather than deterministically as in other studies in the literature, it would be worth assessing whether and to what extent this combination of methods can potentially reconcile differences observed when using the direct response rather than the strategy method, for example, in the ultimatum game. Among other reasons, subjects knowing deterministically when they play what role may look at the decision problem in any role differently than subjects who only know the probability with which they will play in a role and round as from this probability they can only compute the average number of times they will play in each role in an experiment but do not know for sure ex-ante when they will play in a given role.

To keep our experimental design simple, we made a number of simplifying assumptions, relaxing which offers challenges that we plan to address in future research. Perhaps the most important assumption is exogenous selection of principals, which can be relaxed by letting subjects select their role, i.e., principal or agent, based on the expected payoffs associated to each of them. This is in line with the longstanding view that certain individuals, i.e., entrepreneurs, are more talented than others at exploiting profit opportunities (Schumpeter, 1934). Preliminary results in Ponti *et al.* (2017) show that endogenously selected principals choose more efficient contracts, although only in absence of entry costs.

An additional assumption that may be relaxed in future research is that all subjects play either as principals or agents, with no possibility to "opt out", which implies not taking any of the decisions in the role assigned. Since in our design subjects cannot opt out, those who may want do so but cannot may take decisions that are either at random or inefficient, possibly influenced by past contract choices by principals in the event that they were, for example, either inefficient or perceived as "unfair". A related advantage of letting subjects opt out is randomly forcing to opt out an agent in a pair when the other decides to opt out, as this adds some randomness to the otherwise deterministically negative relationship between a subjects' experience as principal and the experience as agent.

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Appendix A: User interface and additional results

Table A.1: Principals' and agents' regressions with controls (linear panel model)

Principals' decisions and profits

	(1)	(2)	(3)	(4)	(5)	(6)
	Rel. ineq./(1+rel. cost)		Efficient contract		Profit/revenues	
RanRole (RR)	0.088**	-0.049**	0.299***	-0.114**	0.104*	0.031*
	(0.037)	(0.021)	(0.104)	(0.049)	(0.059)	(0.018)
HighProf (HP)	0.076**	-0.084***	0.311***	-0.189***	0.228***	0.134
	(0.034)	(0.025)	(0.100)	(0.049)	(0.047)	(0.108)
RR*HP		0.263***		0.795***		0.141
		(0.029)		(0.070)		(0.119)
Constant	0.135**	0.179***	0.143	0.260**	0.091	0.121*
	(0.066)	(0.052)	(0.177)	(0.129)	(0.085)	(0.070)
N	1,453	1,453	485	485	1,453	1,453
RR+0.5RR*HP		0.083***		0.283***		0.101*
		(0.014)		(0.034)		(0.055)
HP+0.5RR*HP		0.048***		0.209***		0.205***
		(0.014)		(0.032)		(0.058)

Agents' effort

	(1)	(2)	(3)	(4)	(5)	(6)
	All agents		Better paid agents		Worse paid agents	
RanRole (RR)	0.189**	0.071*	0.243***	0.073	0.144*	0.066
	(0.080)	(0.042)	(0.084)	(0.050)	(0.081)	(0.041)
HighProf (HP)	0.296***	0.177	0.342***	0.173	0.254***	0.177
	(0.073)	(0.134)	(0.080)	(0.133)	(0.073)	(0.141)
RR*HP		0.223		0.321**		0.147
		(0.150)		(0.152)		(0.156)
Constant	0.045	0.119	-0.031	0.073	0.110	0.158
	(0.095)	(0.100)	(0.096)	(0.092)	(0.105)	(0.114)
N	2,891	2,891	1,445	1,445	1,446	1,446
RR+0.5RR*HP		0.182**		0.233***		0.139*
		(0.073)		(0.074)		(0.076)
HP+0.5RR*HP		0.288***		0.334***		0.250***
		(0.071)		(0.072)		(0.074)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Table A.2: Principals' decisions and profits (Logit, Probit and Tobit panel models without and with controls)

Without controls

	Rel. ineq./(1+rel. cost)		Efficient contract				Profit/revenues	
	Tobit		Logit		Probit		Tobit	
RanRole (RR)	0.094***	(0.026)	1.844***	-0.717*	1.050***	-0.411*	0.232***	0.166**
	(0.023)		(0.454)	(0.427)	(0.261)	(0.240)	(0.046)	(0.066)
HighProf (HP)	0.075***	-0.085***	2.155***	-1.683***	1.250***	-0.898***	0.354***	0.264***
	(0.023)	(0.028)	(0.481)	(0.531)	(0.275)	(0.280)	(0.042)	(0.077)
RanRole (RR)		-0.030		-0.717*		-0.411*		0.166**
		(0.026)		(0.427)		(0.240)		(0.066)
HighProf (HP)		-0.085***		-1.683***		-0.898***		0.264***
		(0.028)		(0.531)		(0.280)		(0.077)
RR*HP		0.252***		4.962***		2.837***		0.126
		(0.037)		(0.724)		(0.386)		(0.091)
Constant	0.022	0.103***	-3.309***	-1.277***	-1.905***	-0.759***	-0.328***	-0.281***
	(0.022)	(0.020)	(0.479)	(0.307)	(0.269)	(0.173)	(0.045)	(0.056)
N	1,536	1,536	512	512	512	512	1,536	1,536
RR MFX		0.096***		0.296***		0.295***		0.229***
		(0.018)		(0.039)		(0.039)		(0.046)
HP MFX		0.041**		0.215***		0.217***		0.327***
		(0.018)		(0.039)		(0.038)		(0.046)

With controls

	Rel. ineq./(1+rel. cost)		Efficient contract				Profit/revenues	
	Tobit		Logit		Probit		Tobit	
RanRole (RR)	0.097***	-0.033	1.843***	-0.844*	1.047***	-0.488*	0.227***	0.182***
	(0.024)	(0.027)	(0.460)	(0.457)	(0.264)	(0.256)	(0.047)	(0.069)
HighProf (HP)	0.079***	-0.070**	1.878***	-1.740***	1.085***	-0.929***	0.359***	0.303***
	(0.024)	(0.027)	(0.501)	(0.525)	(0.288)	(0.276)	(0.046)	(0.078)
RR*HP		0.253***		4.987***		2.850***		0.083
		(0.038)		(0.735)		(0.391)		(0.095)
Constant	0.140*	0.184***	-2.090	-1.438	-1.236	-0.869	-0.069	-0.048
	(0.078)	(0.063)	(1.526)	(1.061)	(0.877)	(0.590)	(0.151)	(0.152)
N	1,453	1,453	485	485	485	485	1,453	1,453
RR MFX		0.097***		0.297***		0.295***		0.225***
		(0.019)		(0.039)		(0.039)		(0.047)
HP MFX		0.050***		0.183***		0.185***		0.342***
		(0.019)		(0.041)		(0.041)		(0.049)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Table A.3: Regressions of agents' effort using Probit and linear probability models

Probit model

Without controls

	All agents		Better paid agents		Worse paid agents	
RanRole (RR)	0.758***	0.291	0.999***	0.353	0.672***	0.265
	(0.181)	(0.260)	(0.196)	(0.279)	(0.215)	(0.318)
HighProf (HP)	1.389***	0.856***	1.538***	0.812***	1.313***	0.864***
	(0.180)	(0.276)	(0.197)	(0.294)	(0.218)	(0.334)
RR*HP		0.860**		1.151***		0.732*
		(0.355)		(0.378)		(0.431)
Constant	-2.108***	-1.817***	-2.229***	-1.811***	-2.143***	-1.896***
	(0.175)	(0.203)	(0.198)	(0.222)	(0.217)	(0.251)
N	3,072	3,072	1,536	1,536	1,536	1,536
RR MFX	0.152***	0.175***	0.200***	0.230***	0.127***	0.141***
	(0.035)	(0.035)	(0.036)	(0.037)	(0.039)	(0.040)
HP MFX	0.279***	0.284***	0.308***	0.319***	0.247***	0.249***
	(0.032)	(0.035)	(0.033)	(0.037)	(0.037)	(0.040)

Probit model with controls

	All agents		Better paid agents		Worse paid agents	
RanRole (RR)	0.773***	0.380	1.063***	0.477	0.662***	0.362
	(0.190)	(0.287)	(0.208)	(0.309)	(0.223)	(0.346)
HighProf (HP)	1.306***	0.920***	1.445***	0.871***	1.226***	0.939***
	(0.192)	(0.283)	(0.211)	(0.303)	(0.230)	(0.338)
RR*HP		0.691*		1.007**		0.517
		(0.385)		(0.412)		(0.461)
Constant	-2.203***	-1.933***	-2.454***	-2.037***	-1.998***	-1.801***
	(0.533)	(0.544)	(0.583)	(0.584)	(0.641)	(0.658)
N	2,891	2,891	1,445	1,445	1,446	1,446
RR MFX	0.152***	0.172***	0.208***	0.236***	0.124	0.135***
	(0.035)	(0.038)	(0.036)	(0.039)	(0.040)	(0.042)
HP MFX	0.258***	0.264***	0.283***	0.297***	0.229	0.232***
	(0.035)	(0.037)	(0.036)	(0.039)	(0.040)	(0.042)

Linear probability model

Without controls

	All agents		Better paid agents		Worse paid agents	
RanRole (RR)	0.189**	0.060	0.234***	0.059	0.149*	0.055
	(0.082)	(0.038)	(0.087)	(0.045)	(0.082)	(0.036)
HighProf (HP)	0.318***	0.165	0.367***	0.163	0.273***	0.163
	(0.074)	(0.135)	(0.080)	(0.132)	(0.074)	(0.143)
RR*HP		0.258*		0.351**		0.188
		(0.148)		(0.147)		(0.156)
Constant	0.011	0.087***	-0.016	0.086***	0.036	0.091***
	(0.057)	(0.029)	(0.064)	(0.030)	(0.055)	(0.030)
N	3,072	3,072	1,536	1,536	1,536	1,536
MFX RR=RR+0.5RR*HP		0.189**		0.234***		0.150*
		(0.074)		(0.074)		(0.078)
MFX HP=HP+0.5RR*HP		0.294***		0.338***		0.257***
		(0.074)		(0.074)		(0.078)

Linear probability model with controls

	All agents		Better paid agents		Worse paid agents	
RanRole (RR)	0.189**	0.071*	0.243***	0.073	0.144*	0.066
	(0.080)	(0.042)	(0.084)	(0.050)	(0.081)	(0.041)
HighProf (HP)	0.296***	0.177	0.342***	0.173	0.254***	0.177
	(0.073)	(0.134)	(0.080)	(0.133)	(0.073)	(0.141)
RR*HP		0.223		0.321**		0.147
		(0.150)		(0.152)		(0.156)
Constant	0.045	0.119	-0.031	0.073	0.110	0.158
	(0.095)	(0.100)	(0.096)	(0.092)	(0.105)	(0.114)
N	2,891	2,891	1,445	1,445	1,446	1,446
RR+0.5RR*HP		0.182**		0.233***		0.139*
		(0.073)		(0.074)		(0.076)
HP+0.5RR*HP		0.288***		0.334***		0.250***
		(0.071)		(0.072)		(0.074)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses.

Figure A.1: Phase 1 user interface

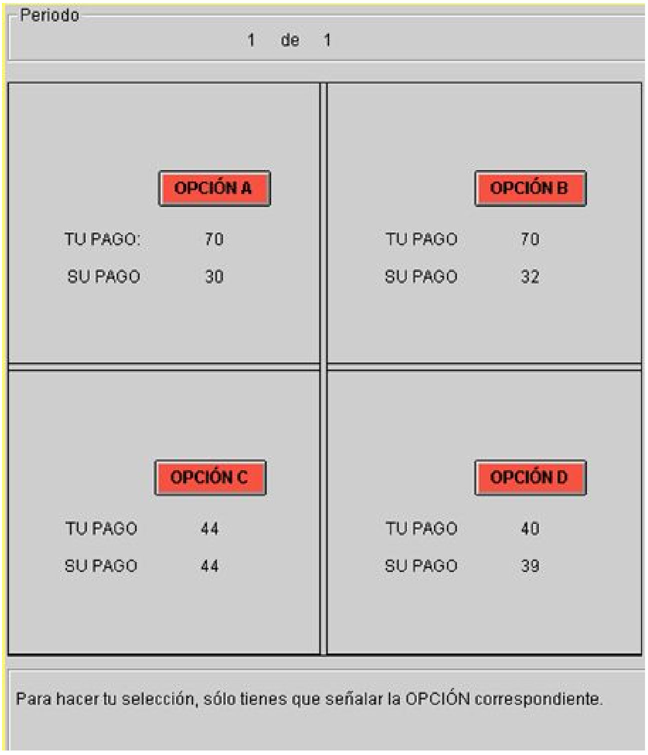


Figure A.2: Phase 2 user interface

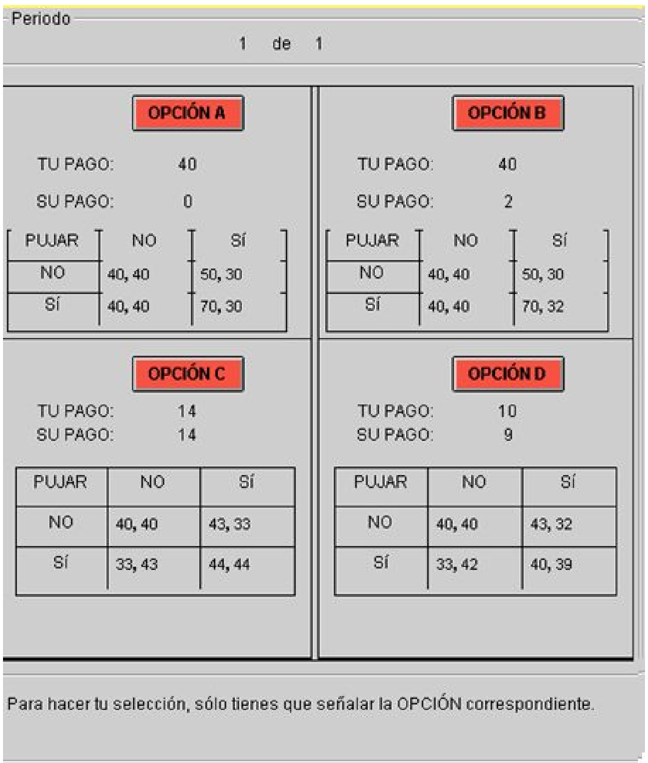
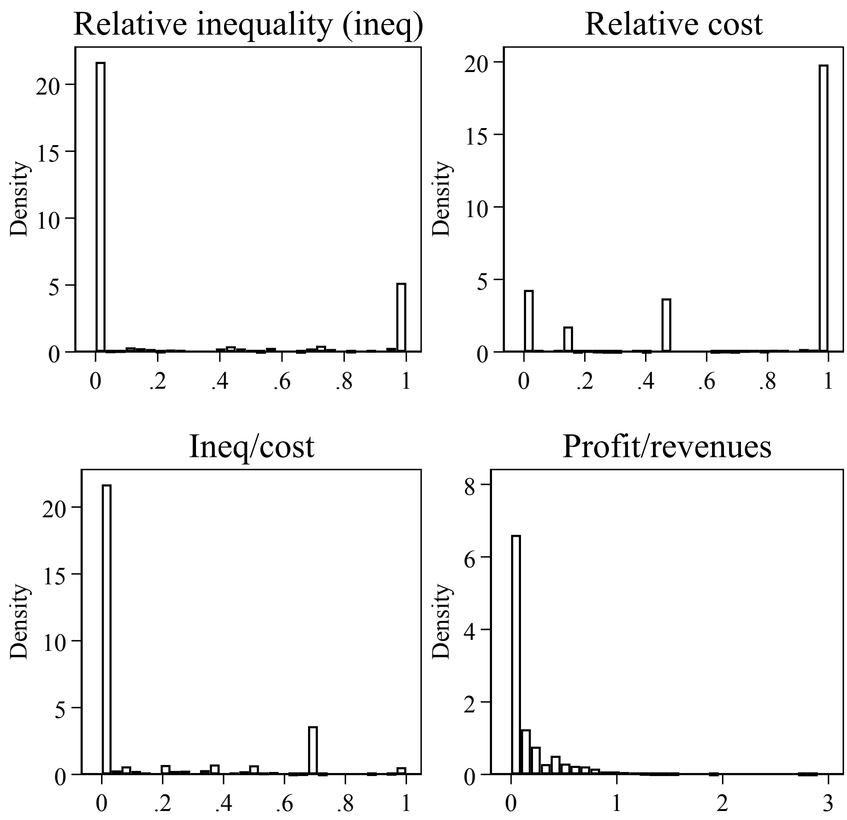


Figure A.3: Histograms of measures of principals' contract choice and profit



Appendix B: Experimental instructions

WELCOME TO THE EXPERIMENT!

- This is an experiment to study how people take decisions. We are only interested in what people do on average. Please, do not think that we expect a particular behavior from you. On the other hand, keep in mind that your behavior will affect the amount of money that 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 disturb the other participants during the experiment. If you need help, please 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 into 3 PHASES, and every PHASE has 24 rounds.

The payoffs are defined in pesetas, whose exchange rate is 100 pesetas for 0.601 euros.

PHASE 1

- In each of the 24 rounds in PHASE 1, you will play with ANOTHER PLAYER in this room.
- The identity of this person will change from one round to the next. You will never know if you interacted with the OTHER PLAYER in the past, nor the OTHER PLAYER will ever know if he has interacted with you. This means that your choices will always be anonymous.
- In each round in PHASE 1, the computer will first randomly choose 4 different OPTIONS, that is, four monetary payoff pairs, one for you and one for the OTHER PLAYER. Every OPTION will always appear on the screen.

- Then, you and the OTHER PLAYER have to choose, simultaneously, your favorite OPTION.
- Once you and the OTHER PLAYER have chosen, the computer will randomly determine who (either you or the OTHER PLAYER) decides the OPTION for the pair.
- We will call this player the CHOOSER of the game.
- The identity of the CHOOSER is randomly determined in each round.
- On average half of the times you will be the CHOOSER and half of the times the OTHER PLAYER will be the CHOOSER.
- Then, in each round, the monetary payoffs that both players receive are determined by the choice of the CHOOSER.

PHASE 2

- In each of the 24 rounds in PHASE 2, you will play with ANOTHER PLAYER in this room.
- The identity of this person will change from one round to the next. You will never know if you interacted with the OTHER PLAYER in the past, nor the OTHER PLAYER will ever know if he has interacted with you. This means that your choices will always be anonymous.
- In each round in PHASE 2, the computer will first randomly choose 4 different OPTIONS, that is, four payoff matrices, one for you and one for the OTHER PLAYER. Every OPTION will always appear on the screen.
- Then, you and the OTHER PLAYER have to choose, simultaneously, your favorite OPTION.
- Once you and the OTHER PLAYER have chosen, the computer will randomly determine who (either you or the OTHER PLAYER) decides the OPTION for the pair.

- We will call this player the CHOOSER of the game.
- The identity of the CHOOSER is randomly determined in each round.
- On average half of the times you will be the CHOOSER and half of the times the OTHER PLAYER will be the CHOOSER.

Player 1/2	No bid	Bid
No bid	40,40	$40 + \frac{b_1}{4}, 30 + \frac{b_2}{4}$
Bid	$30 + \frac{b_1}{4}, 40 + \frac{b_2}{4}$	$30 + b_1, 30 + b_2$

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, and not bidding does not cost anything.
- You choose a ROW, the OTHER PLAYER chooses a COLUMN.
- Every cell in the matrix (which depends on the monetary payoffs b_1 and b_2 and on your decisions on whether or not to bid) contains two numbers.
- The first number (on the left) is what you win in this round. The second (on the right) is what the OTHER PLAYER wins in this round.
  There are four possibilities:

1. If both players bid, both add to their initial endowment their ENTIRE MONETARY PAYOFF b_1 or b_2 (to which the 10 pesetas cost of bidding will be subtracted).

2. If you bid, and the OTHER PLAYER does not, both players add to their endowment ONE FOURTH of the monetary payoff b_1 or b_2 (and the cost of bidding will be subtracted from you only).

3. If the OTHER PLAYER bids, and you do not, both players add to their endowment ONE FOURTH of their monetary payoff b_1 or b_2 (and the cost of bidding will be subtracted from the OTHER PLAYER only).

4. If nobody bids, you and the OTHER PLAYER will only obtain the 40 pesetas endowment.

Phase 2 consists of 2 STAGES:

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

Summing up

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

- In STAGE 1, you and the other player, have to choose simultaneously your favorite OPTION.
- After you and the OTHER PLAYER have chosen an OPTION, the computer will randomly determine which one of those OPTIONS is 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 the choices (to bid or not to bid) of both players, on the OPTION chosen by the CHOOSER and on the cost of bidding of 10 pesetas.
- The PAYOFF MATRIX (which is on the left-hand side of your screen) sums up the monetary consequences of your choices in a compact form.

PHASE 3

- In each of the 24 rounds in PHASE 3, you will play a game similar to the one in PHASE 2 but with some modifications.
- Among the 24 people in this room, the computer will randomly select two groups of 12.
- In each group of 12 people, the computer will select randomly 8 PLAYERS and 4 REFEREES.

Phase 3 consists of 3 STAGES:

- As in the previous phase, in STAGE 1 the computer randomly selects 4 OPTIONS and shows them on the screens of referees only.
- Then, each REFEREE chooses simultaneously one OPTION among the 4 in a round (they can choose the same option or different ones).
- The PLAYERS see on the screen 4 OPTIONS which correspond to the 4 OPTIONS chosen by the REFEREES.

- In STAGE 2 the 8 PLAYERS in each group are paired randomly and they are re-matched every round.
- Once the 4 REFEREES have chosen the OPTION that each will offer and the 8 PLAYERS have each chosen an OPTION among the ones offered by the REFEREES, the computer will randomly determine the CHOOSER.
- Different CHOOSERS may choose the same OPTION or they may all choose a different OPTION.
- In STAGE 3 when the CHOOSER's decision has determined the game, everything proceeds as in phase 2, with pairs of PLAYERS who decide whether to BID or NOT to BID. The PLAYERS' monetary payments are the consequence of their decisions, as in phase 2.

REFEREES' PAYOFF

The REFEREES' payoff depends on the OPTION which they offer, on how many REFEREES offer the same OPTION, on how many CHOOSERS choose the same OPTION, and on the actions of the PLAYERS who choose that option. Let us clarify this:

CASE 1

First, suppose that the REFEREE offered an OPTION with payoffs (b_1, b_2) and that only one CHOOSER has chosen this option. The payoff of each REFEREE depends on the positive VALUE V randomly generated by the computer and that each REFEREE (and only her) knows. It also depends on the sum of the payoffs $b_1 + b_2$ in the following way:

1. If both PLAYERS bid, the REFEREE obtains the difference between the positive VALUE V and the sum of the payoffs $b_1 + b_2$, that is $V - (b_1 + b_2)$.
2. If one PLAYER bids and the other does not, the REFEREE obtains ONE FOURTH of the difference between his VALUE V and the sum of the payoffs $b_1 + b_2$, that is $\frac{V-(b_1+b_2)}{4}$.

3. If nobody bids, the REFEREE does not obtain anything.

In this case, the PAYOFF MATRIX for the REFEREE is:

Player 1/2	No bid	Bid
No bid	0	$\frac{V-(b_1+b_2)}{4}$
Bid	$\frac{V-(b_1+b_2)}{4}$	$V-(b_1+b_2)$

CASE 2

Suppose now that more than one CHOOSER chose the option that the REFEREE offered. Moreover, suppose that this REFEREE is the only one who picked this OPTION. In this case, the REFEREE obtains the sum of the payoffs from each pair of players who chose her OPTION. The payoff from each pair is determined as in CASE 1, by taking into account if both players bid, if only one bids or if nobody bids.

CASE 3

Assume 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 who chose the same OPTION obtains a payoff with the same structure as in CASE 2, but now shares it with the other REFEREES who picked the same OPTION.

CASE 4

Assume now that no CHOOSER picked the option that a REFEREE offered. In this case, the REFEREE'S payoff for this round is 0.

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