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ARTICLE

Self-selection bias in a field experiment: Recruiting subjects under different payment schemes

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Abstract

We examine a potential self-selection bias in different samples of experimental subjects depending on the payment scheme offered in the recruiting process. We ran four field experiments in which undergraduate students in a microeconomics course were invited to voluntarily set their own goal for the final exam. They were informed that they would be given a monetary reward (else nothing) if their actual grade were higher than or equal to their goal. Rewards were an increasing (quadratic) function of the goal. We aimed at studying whether subjects' willingness to participate in the experiment depends on their expected performance under different advertised reward criteria, like a rank-order tournament and piece-rate pay. Given that judgments about future performance are closely tied to previous performance, the midterm exam scores from the current academic course are compared between participants and nonparticipants in order to analyze sample-sorting effects. We find that when a rank-order tournament is offered alone or in combination with another reward mechanism, high-performing students are more

likely than low-performing ones to participate in the experiment.

KEYWORDS
piece-rate rewards, rank-order tournament, self-selection bias

JEL CLASSIFICATION
C81, C93

1 | INTRODUCTION

Voluntary participation and real incentives are two fundamental features of economic experiments. According to Krawczyk (2011) and Abeler and Nosenzo (2015), subjects participate in experiments primarily in order to earn money. Thus, it could be the case that self-selection into a given experiment is the result of the subjects' cost–benefit considerations (Al-Ubaydli & List, 2015). Consistent with this hypothesis, Slonim et al. (2013) found that students participating in lab experiments had less income and more recreation time than the general population. However, subjects are generally not informed about the nature of the task to be performed and the payment scheme used to reward them, thereby making it difficult for them to accurately calculate their expected payoffs at the moment of deciding whether to respond to a recruitment call. In that sense, a practical recommendation for experimentalists is to be careful with participants' expectations of rewards generated during their enlistment (Harrison et al., 2009).[1] Following this suggestion, in order to reduce the self-selection bias Slonim et al. (2013) recommended reducing the information on the nature of the task when recruiting. However, this is often difficult, if not impossible, to accomplish, especially when word-of-mouth is possible among participants in repeated experimental sessions taking place on several days.

The main goal of this paper is to study whether experimentalists should try to blur subjects' profit expectations in the recruiting process in order to avoid potential self-selection effects. We conduct four field experiments in which students are invited to set their own target mark in the final exam of an undergraduate Microeconomics course. Subjects were informed that if their final exam grade exceeded or was equal to the self-chosen goal, they would receive a monetary reward according to an increasing function of the goal. By means of different recruitment announcements, we varied the payment mechanism offered to reward successful students. Given that past research has shown a performance bias[2] (Kornell & Hausman, 2017), we use a student's score in the midterm exam as a proxy of the student's expected payoff in the experiment. In this way, significant differences in the midterm exam scores between participants and nonparticipants would alert us on the presence of sorting effects based on subjects' estimated rewards.

The potential self-selection effect is analyzed when piece-rate and rank-order tournament payment schemes are offered alone or in combination with some other type of payment mechanism.

[1] In order to test the effect of variations in the recruitment information, they varied the range of possible rewards announced, finding that participants responding affirmatively to a recruitment email advertising a lower payoff variance were more risk averse in the laboratory experiment.

[2] This bias refers to the tendency of subjects to expect that their future performance on a task will match their present performance, even when there are arguments to expect the contrary.

Thus, given that, in each of our field experiments, subjects could not choose their payment scheme, their participation decision is conditioned by their expected profits. When payment schemes are endogenous, the literature suggests that higher ability subjects auto-select themselves into more competitive payment schemes. Specifically, Leuven et al. (2011) studied tournament-participation decisions, reporting that when top students had the possibility to choose between different tournaments, they chose to play tournaments with higher prizes. This sorting effect has been found in other performance areas like golf (Brown, 2011), running (Azmat & Möller, 2009), or chess tournaments (Linnemer & Visser, 2016).

The structure of the paper is organized as follows: first, we introduce the design of the experiment that was implemented and the measures used; after that, we analyze the empirical evidence collected and present our results; and lastly, we conclude.

2 | EXPERIMENTAL DESIGN

We conducted four field experiments aimed at improving academic performance through monetary incentives, offered on the basis of self-chosen goals.[3] In each experiment, students enrolled in a microeconomics course at the Universitat Jaume I (Spain) were offered the possibility of taking part in a monetary incentive program, invited to voluntarily respond to a recruitment call. Students' evaluation in the course included a midterm exam (representing 30% of the final grade) and a final exam (representing 70% of the final grade). This process was initiated following their midterm exam by means of an email in which they were informed about the payment schemes that they would be used to reward them. This protocol and the entire project had previously received financial support and was approved by the Faculty of Law and Economics as a pilot educational project on performance-improving extrinsic incentives.

In the first experiment, in which a rank-order tournament was proposed as the payment mechanism, subjects responding affirmatively were assigned to Group 1 (G1) and the remaining students were classified as nonparticipants (G2). In the second experiment, in which a piece-rate system was used to reward subjects, volunteer students were assigned to G3, and nonparticipants to G4. Students willing to participate in the third experiment (G5) were informed that they would be randomly rewarded with one of three different incentive systems: piece rate, rank-order tournament, and hypothetical earnings. Nonparticipants were included in G6. Lastly, volunteers in the fourth experiment (G7) were told that they could be remunerated randomly with either real (piece-rate) or hypothetical monetary incentives. Nonvolunteers were grouped in G8.[4] No show-up fee was offered in any experiment in order to avoid potential wealth effects affecting self-chosen goals and looking for comparability among payment mechanisms.

Table 1 summarizes the groups discussed above, providing the resulting sample sizes.

In each experiment, students were informed that their reward (R) would depend on their self-chosen goal (G), and the grade (GR) they obtained in the corresponding exam, according to the following function:

$$R = G^2 \quad \forall\, GR \geq G.$$

[3] The joint effectiveness of self-chosen goals and real monetary incentives on the performance of students in higher education is shown in Herranz-Zarzoso and Sabater-Grande (2018a, 2018b, 2020).

[4] It is worth to mention that different subjects cannot belong to different groups in different experiments.

TABLE 1 Summary of groups

	Group	Number of subjects	Willingness to participate	Incentive systems used
Experiment 1	G1	134	Yes	Rank-order tournament
	G2	256	No	–
Experiment 2	G3	69	Yes	Piece rate
	G4	41	No	–
Experiment 3	G5	94	Yes	Piece rate, Rank-order tournament, hypothetical
	G6	187	No	–
Experiment 4	G7	100	Yes	Piece rate, hypothetical
	G8	160	No	–

TABLE 2 Participation rates, midterm, and final average grades, and Mann–Whitney test *p*-values

	Participation rate (%)	Incentive systems used	ME grades			FE grades	
			P	NP	MW test*p*-value	P	NP
Experiment 1	34.36	Rank-order tournament	5.48	4.69	0.0028***	5.13	3.72
Experiment 2	62.73	Piece rate	5.28	5.15	0.8857	5.56	3.86
Experiment 3	33.45	Piece rate, rank-order tournament, control	5.10	3.35	0.0000***	4.08	1.86
Experiment 4	62.50	Piece rate, control	3.66	3.37	0.1982	4.75	4.29

Abbreviations: FE, final exam; ME, midterm exam; NP, Nonparticipants; P, Participants.

Under the piece-rate mechanism, all students whose grade was higher than or equal to their goal earned *R* euros. In the rank-order tournament and specifically, in experiments 1 and 3, the top three students obtained three prizes (first prize, 180 euros; second prize, 80 euros; third prize, 50 euros) according to their position in the corresponding ranking.[5] Participants were informed in the instructions that the results of the ranking would be communicated to them immediately after the publication of the definitive grades.

3 | RESULTS

In this section, we analyze potential self-selection effects by comparing midterm grades between volunteer and nonvolunteer students in each call.

Table 2 presents participation rates, midterm average grades corresponding to both participants and nonparticipants, and a Mann–Whitney test comparing median midterm grades of volunteers and nonvolunteers for each field experiment.

On looking at the participation rates, a clear pattern is detected: when a rank-order tournament is proposed as the payment mechanism either exclusively or in combination with others, the participation rate barely exceeds 30%. Alternatively, when subjects are rewarded by means of a piece-rate system, the participation rate increases to above 60%. Note that the midterm exam marks are not appropriate for comparisons across experiments as they are the result obtained in

[5] Note that, in experiment 1, any of the 134 subjects could aspire to one of thethree prizes. In experiment 3, only 32 (randomly selected) out of the 94 participantscould aspire to one of the three prizes.

TABLE 3 OLS models of self-selection

	Experiment 1	Experiment 2	Experiment 3	Experiment 4
Participation	0.761***	0.0413	1.754***	0.228
	(0.274)	(0.433)	(0.332)	(0.293)
Gender	0.352	−1.315***	0.0947	−0.318
	(0.261)	(0.416)	(0.316)	(0.287)
Constant	4.528***	5.954***	3.302***	3.543***
	(0.200)	(0.432)	(0.241)	(0.233)
Observations	390	104	281	235
R-squared	0.026	0.091	0.091	0.008

Standard errors are in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

different exams, possibly of a different difficulty levels. Thus, the discussion is limited to within-treatment comparisons.

When the midterm grades of volunteers and nonvolunteers are compared, we find that participants' midterm grades are significantly higher than the midterm grades obtained by nonparticipants only when a rank-order tournament is offered uniquely or in conjunction with another payment mechanism. This result suggests that when students' profit expectations depend on a rank-order tournament a self-selection problem can arise because less confident students are discouraged from participating. Nevertheless, this bias is not found when all subjects are rewarded depending on their performance, in spite of being informed in the recruiting process about the task to be performed and the payment scheme offered. These results are corroborated by means of four regressions estimated by ordinary least squares (OLS) as presented in Table 3. In the models displayed, the dependent variable is the midterm exam grade for each experiment and the main explanatory variable is the dummy variable "participation" capturing the effect of those subjects who participated in each experiment depending on the payment scheme offered. The gender dummy accounts for any gender differences.

As can be seen in the models, the previous findings are confirmed, suggesting that only the rank-order tournament (alone or in combination with other payment schemes) induces the self-selection of subjects based on expected payoffs. Additionally, we can discard the influence of gender on this self-selection result.

4 | CONCLUSIONS

We have analyzed the presence of self-selection effects, depending on the payment mechanism offered during the recruiting process. Our empirical evidence suggests that when all subjects are paid for their performance, no sorting effects are found based on subjects' profit expectations. From this point of view, when all subjects are rewarded depending on their performance, recruiting subjects who have been informed about the nature of the task and the payment mechanism may be less problematic than previously stated in the literature.

However, when potential subjects know that their experimental rewards will depend on a rank-order tournament, high-performing subjects are more likely to be willing to participate in the experiment than their low-performing peers. From this perspective, the lack of representativeness of the recruited sample could be a serious concern affecting the external validity of the

experimental results. If the use of tournament-like reward systems is absolutely necessary for the purposes of the experiment, avoiding any information concerning the reward method is a necessary strategy at the recruitment stage in order to avoid self-selection biases. Furthermore, given that participants in early sessions of an ongoing experiment often share their experience with colleagues who will participate in a later session, the most effective recruitment policy seems to be never to start an experiment before the full sample participating in it has been recruited.

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