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# Spread of Information, Inequality and Cooperation

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**Abstract**

With the rise of information technologies, citizens can compare public good efficiencies between countries easier now and being aware of large efficiency differences may affect tax compliance behavior. We experimentally test whether contributions in the public goods game are sensitive to comparative information regarding marginal per capita returns of other groups. Our experimental results indeed suggest that comparative information creates polarization in contribution levels in the presence of large inequality between comparison groups.

**Keywords:** Public Goods; Inequality; Cooperation; Information; Experiment

**JEL Codes:** C9, D8, H4

## 1 Introduction

Internet and social media, have immensely increased the spread of news globally. Citizens now receive more information about developments around the world and commonly compare their own countries to others. For instance, Programme for International Student Assessment (PISA) studies of OECD show worldwide levels of education and the findings are well spread both in mass and social media. As a result, citizens of participating

countries are informed more accurately about the quality of their countries' education systems. Such type of information regarding inequalities between countries can have a great impact on tax compliance behavior as they shape taxpayers' perceptions regarding the efficiency of public policies.

Individuals show greater support for public good projects that they gain higher benefits from (Olson, 2009). This observation has been repeatedly confirmed by experimental studies (Kölle, 2015; Ledyard, 1995; Lugovskyy et al., 2017; Reuben & Riedl, 2009, 2013; Tan, 2008). However, the role of information in public goods games is not entirely clear. On the one hand transparency might increase contributions (Davis et al., 2010; Fischbacher et al., 2001; Friedman, 1971; Fudenberg & Maskin, 2009). On the other hand, information about other group members' payoffs decreases the contributions (Fiala & Suetens, 2017; Nikiforakis, 2010). It is suggested that payoff based learning yields contribution decline in repeated public goods games (Burton-Chellew et al., 2015).

The common feature of those studies investigating the role of information on public goods provision is that they manipulate the information and feedback schemes within groups. Meaning that, the payoffs of group members are directly affected by the decisions of other members of the same group. However, both economic and social decisions outside the laboratory are also affected by *economically irrelevant* information as a body of literature documented (e.g. Easterlin, 2001; Luttmer, 2005). Further examples regarding economic behavior suggest that social comparison information shapes work productivity (Charness et al., 2016; Cohn et al., 2014; Gächter & Thöni, 2010), risky decisions (Gamba et al., 2017; Linde & Sonnemans, 2012; Schmidt et al., 2019) and charitable giving (Frey & Meier, 2004).

In this study, we experimentally test whether public goods contributions are sensitive to information regarding marginal per capita return ($m$) inequalities *between* groups. We also test whether the size of inequality plays a role. Our results suggest that information on $m$ inequality yields a polarization in contributions if the inequality is large. We do not observe such a polarization when the $m$ inequality between groups is small.

# 2 Methods

## 2.1 Experimental Procedures

The experiment was run at EGEO, the experimental lab in Faculty of Economics and Business of University of Granada in Spain and conducted with Z-tree software (Fischbacher, 2007). The participants were recruited through ORSEE (Greiner, 2015). The total number of participants was 183 (female=106), who were students of the School of Business and Economics.[1]

In each session, participants were randomly assigned to the computers and their groups. Following several control questions and two trial periods, players were informed about their own $m$ and also the $m$ of the other two members in their groups on their screens. Meaning that, the $m$'s of group members were common knowledge in each group. After participants completed the experiment they were paid confidentially for a randomly selected round and left the lab. The duration of a session was about 1 hour. Participants earned 13.41 Euros in average (including 3 Euros show up fee).

## 2.2 Experimental Design and Treatments

Our experiment used a standard linear public goods game design. Each group had three players and each group member had the same $m$ (i.e. homogeneous groups). Each player made a contribution decision from her endowment of 20 tokens in each period ($c_i \in [0, 20]$; exchange rate of a token was 0.33 Euros). Payoff function of the players is as follows:

$$\pi_i = (w_i - c_i) + m_i \times \sum_{j=1}^{3} c_j, \tag{1}$$

where $w_i$ is the initial endowment of subject $i$, $c_i$ is her contribution to the public pool and her $m_i$ is the marginal per capita return. $c_j$ stands for the contributions of the other players in the same group. The experiment was run for 10 periods. In all treatments, participants were given full information about their own payoffs and also a vector showing

[1]Each treatment contains 18 participants (6 groups) except for T7 and T8. In T7-T8 the number of participants are 39 and 36.

contributions of each group member after each period.

There were four $m$ levels in the experiment: *0.4, 0.5, 0.75, 0.9* and 8 treatments (See Table 1). In the first four treatments we investigate the *Large-Inequality* environment. In these treatments, players had either a low (*0.4*) or a high (*0.9*) $m$. Players in treatments T1 and T2 knew only their own group's $m$ level where the players in treatments T3 and T4 were also aware of the $m$ level of each other. In the latter four treatments (T5-T8) we studied the *Small-Inequality* environment. While the *Small-Inequality* treatments were symmetrical to *Large-Inequality* treatments, the low $m$ was *0.5* and the high $m$ was *0.75*. Note that in the *Large-Inequality* environment there existed a larger difference between two $m$'s (*0.5*) where in the *Small-Inequality* environment the difference was precisely the half (0.25).

Table 1: Experimental Treatments

| Treatment | $m$ | Comparative-Info. |
|---|---|---|
| | *Large-Inequality* | |
| T1 | 0.4 | No |
| T2 | 0.9 | No |
| T3 | 0.4 | Yes |
| T4 | 0.9 | Yes |
| | *Small-Inequality* | |
| T5 | 0.5 | No |
| T6 | 0.75 | No |
| T7 | 0.5 | Yes |
| T8 | 0.75 | Yes |

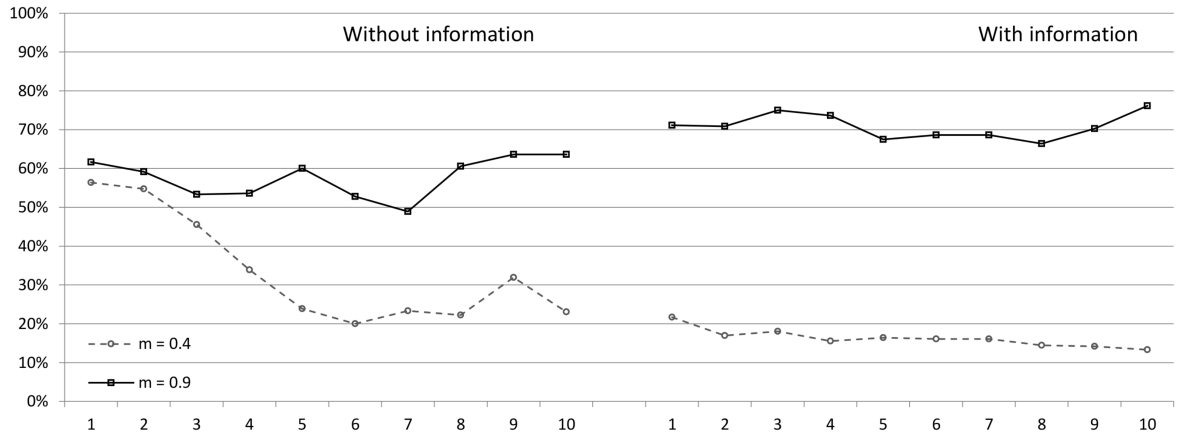
To summarize, T3 and T4 in the *Large-Inequality* environment and the T7 and T8 in the *Small-Inequality* environment are our *Comparative-Information* treatments. In addition to their groups' $m$, participants in these treatments were informed about the existence of another group with a different $m$ in the instructions. The exact wording in the instructions was as follows: "In this experiment you may have a multiplication factor of 0.4 (0.5 in *Small-Inequality*) or 0.9 (0.75 in *Small-Inequality*)." In the remaining groups, participants knew only their own groups' $m$. For convenience we will call players with high $m$ (0.75 and 0.9) privileged and players with low $m$ (0.4 and 0.5) underprivileged. Several studies use the term *privileged* for $m > 1$, where dominant strategy is to contribute all. In our study, this is not the case. The dominant strategy is to free-ride in all our treatments.

# 3 Results

## 3.1 Large-Inequality

Figure 1 shows the contribution trends in Large-Inequality treatments ($m$= *0.4* and *0.9*) where left panel shows treatments without comparative information and the right one treatments with comparative information. Without information, underprivileged players ($m$=*0.4*) start contributing at 56% and reduce until 22%. Privileged players also start around 60% but do not exhibit a decline. In the information condition, informed underprivileged players start contributing at remarkably low rates and they exhibit a gentle decline. In summary, the contributions of informed underprivileged players are significantly lower than uniformed underprivileged players (means: $Low_{noinfo} = \%33.50$; $Low_{info} = \%16.28$; $p = 0.003$). On the contrary, privileged players ($m$=*0.9*) start contributing at a very high level (70%) and continue contributing consistently until the end of the game. Hence, there is no decline. Although the contribution pattern of privileged gets more stable with information, statistical tests do not detect a significant difference between informed and uninformed privileged players on average (means: $High_{noinfo} = \%57.72$; $High_{info} = \%70.81$; $p = 0.195$). Figure A1 and Figure A2 show average contributions in the first 5 and last 5 periods.

Figure 1: Contributions along 10 periods: Large-Inequality




Panel regression analysis is presented in Table 2. The impact of information on contributions is significant for underprivileged groups ($p = 0.023$) but not in privileged groups

($p = 0.903$). Furthermore, the *period* is not significant for privileged groups, meaning that there is no significant contribution decay along 10 periods. See Table A1 for the regression analyses by inequality sizes.

Table 2: Regressions by $m$ levels

| | $m = 0.4$ | $m = 0.5$ | $m = 0.75$ | $m = 0.9$ |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| $info$ | -0.172** | 0.027 | -0.014 | 0.131 |
| | (0.076) | (0.094) | (0.118) | (0.120) |
| *period* | -0.022*** | -0.032*** | -0.023*** | 0.001 |
| | (0.006) | (0.007) | (0.007) | (0.008) |
| constant | 0.455*** | 0.634*** | 0.689*** | 0.569*** |
| | (0.058) | (0.099) | (0.113) | (0.093) |
| Observations | 360 | 570 | 540 | 360 |
| N | 36 | 57 | 54 | 36 |
| $R^2$ | 0.200 | 0.085 | 0.040 | 0.035 |

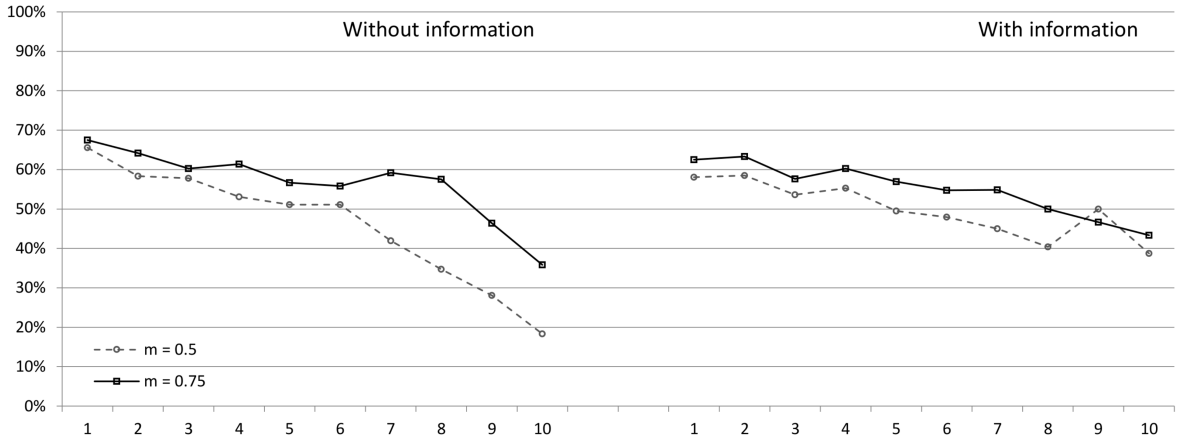
Panel regressions. Dependent variable: Contributions [0,1].
info=1 for comparative information treatments, period is the time variable [1,10]. Robust standard errors in parentheses.* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; regressions were clustered by groups.

## 3.2 Small-Inequality

Figure 2 presents the Small-Inequality treatments ($m$= *0.5* and *0.75*).The common contribution decline patterns are observed in all treatments. Contributions begin around 60% of the endowment in period 1 and they decrease gradually. In Small-Inequality case, we do not observe any significant treatment effects caused by comparative information neither for underprivileged (Means: $Low_{noinfo} = \%46.00$; $Low_{info} = \%48.73$; $p = 0.619$) nor for privileged players (Means: $High_{noinfo} = \%56.47$; $High_{info} = \%55.03$; $p = 0.614$). Figures A1 and A2 show average contributions in the first 5 and last 5 periods.

Regression analyses do not detect a significant effect of $info$ on contributions in the Small-Inequality treatments and decline pattern is significant in all treatments (See Tables 2 and A1 for regression analyses).

Figure 2: Contributions along 10 periods: Small-Inequality




# 4 Conclusion

In this experimental study, we investigated whether being exposed to comparative information, that makes the economic inequality more salient, affects individuals' contribution decisions in a linear public goods game. Since the members of each group have the identical $m$ levels (i.e. homogeneous groups) the comparative information they receive should not affect their contributions theoretically. Yet, our results in the Large-Inequality treatments show the otherwise. The contribution difference between underprivileged (0.4) and privileged (0.9) groups widens when they learn about the existence of each other. Our analyses show that this effect is mainly due to a decrease in underprivileged groups' contributions: informed underprivileged groups contribute extremely low, starting from the first period. This might imply that in the existence of large inequality, *warm-glow of giving* almost disappears with the comparative information.

People now receive more information and they compare themselves or their countries to relative others easily today. Our results suggest that information might have adverse consequences as economic and social inequalities are rising today (Piketty, 2014). As in previously given PISA example, tax-payers who are informed about their countries' low scores might end up evading taxes. However, decreasing the economic and social inequalities might help as our experimental results did not detect such an impact of comparative information in Small-Inequality treatments.

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# Appendix

Figure A1: Average contributions: First 5 periods

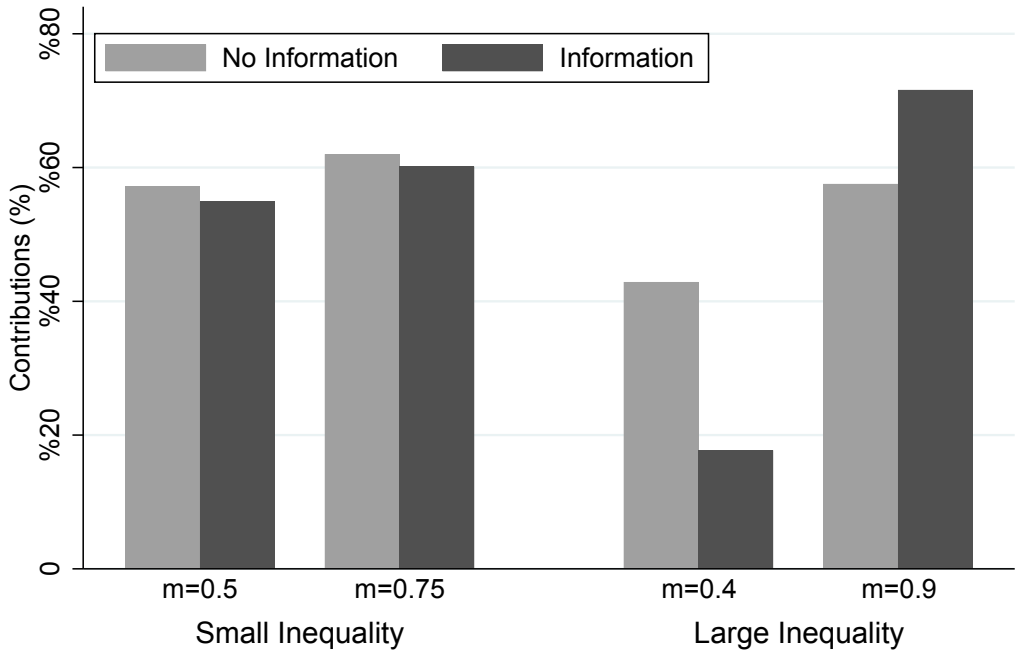

Figure A2: Average contributions: Last 5 periods

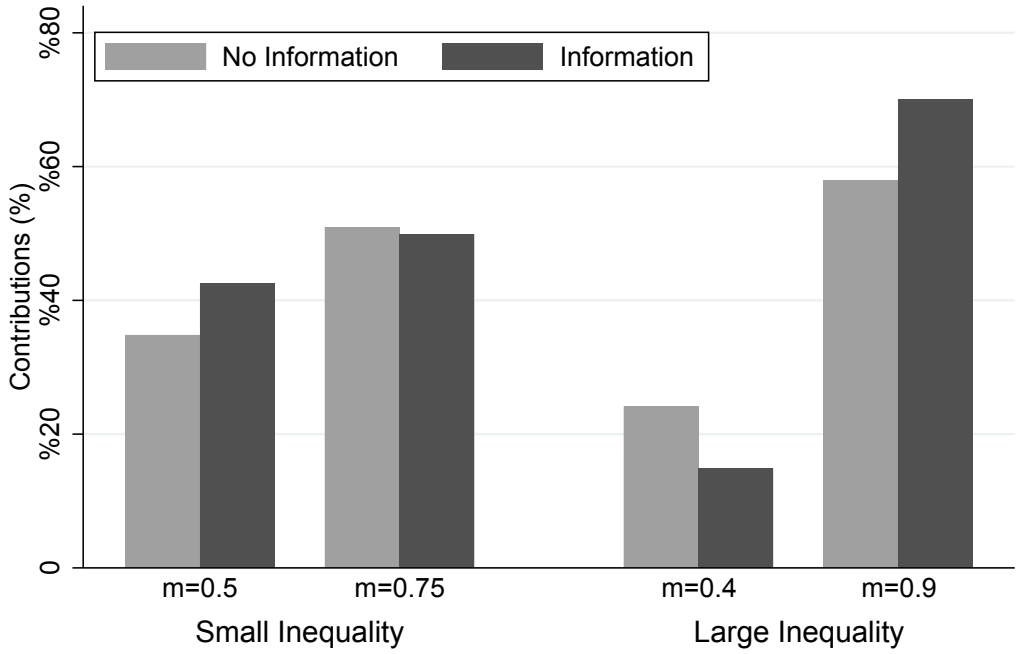


Table A1: Regressions by the Size of Inequality

| | Large-Inequality | | | | Small-Inequality | | | |
|---|---|---|---|---|---|---|---|---|
| | All | All | No-Info | Info | All | All | No-Info | Info |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $m$ | 0.788*** | 0.484** | 0.484** | 1.091*** | 0.306 | 0.419 | 0.419 | 0.252 |
| | (0.152) | (0.220) | (0.225) | (0.173) | (0.244) | (0.540) | (0.557) | (0.252) |
| $info$ | -0.021 | -0.415** | | | 0.007 | 0.111 | | |
| | (0.076) | (0.163) | | | (0.074) | (0.363) | | |
| $period$ | -0.010* | -0.010* | -0.017* | -0.004 | -0.027*** | -0.027*** | -0.037*** | -0.023*** |
| | (0.005) | (0.005) | (0.009) | (0.006) | (0.005) | (0.005) | (0.007) | (0.007) |
| $m$X$info$ | | 0.606** | | | | -0.167 | | |
| | | (0.277) | | | | (0.595) | | |
| constant | 0.001 | 0.197 | 0.233* | -0.252** | 0.471*** | 0.400 | 0.453 | 0.486*** |
| | (0.110) | (0.132) | (0.138) | (0.109) | (0.154) | (0.328) | (0.354) | (0.167) |
| Observations | 720 | 720 | 360 | 360 | 1110 | 1110 | 360 | 750 |
| N | 72 | 72 | 36 | 36 | 111 | 111 | 36 | 75 |
| $R^2$ | 0.307 | 0.351 | 0.135 | 0.560 | 0.073 | 0.074 | 0.100 | 0.060 |

Panel regressions. Dependent variable: Contributions [0,1]. Independent variables: i) $m$; ii) $info$ is a binary variable; iii) $period$ [0,10]; iv) $m$X$info$ interaction variable. Robust standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$; regressions were clustered by experimental groups of three.

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