Analysis of altruism through the Public Good Game

Student: Sergio Gimeno Simó

al363365@uji.es

Bachelor's Degree in Economics

Course 2019-2020

Supervisor: María Aurora García Gallego

Keywords: public good game, game theory, altruism.

JEL Classification: H41, C70, D64.

Abstract

Literature picks up different ways to estimate altruism and altruistic behavior in the context of the Public Good Game. The objective of this essay is comparing various methodologies and procedures used for evaluating the altruistic behavior. In this dissertation, a questionnaire is carried out for contrasting two methodologies used for testing altruistic behavior. The first procedure is based on Kurzban and Houser (2005) and the second one, developed from an idea considered in Alexander and Fotini (2011). Results present that the second methodology is more permissive than the first one. Moreover, results show that gender has not an effect in how altruistic a subject is. Behavior of subjects with postgraduate level of studies is less altruistic than behavior of subjects with lower level of education. Finally, results show that subjects classified as cooperators often have altruistic motivations in their behavior.

Index

Introduction

The objective of this dissertation is comparing various methodologies and procedures used for evaluating the altruistic behavior in the context of the Public Good Game. Moreover, differences in altruism behavior of various demographic groups are tested. In other words, this dissertation aims to investigate altruism in social dilemmas.

To apply some concepts and theories learned during the degree of Economics is the main personal motivation to carry out this dissertation. Moreover, it is a good opportunity for investigating some specific topics like altruism, Public Good Games, Game Theory and Experimental Economics.

Zelmer (2003) defines a public good game as a situation where subjects are distributed into groups. Each period every subject is endowed with an income and the subject must then distribute the endowment between a contribution to a private account that yields a constant return to themselves only and a contribution to a public account where consumption benefit accrues to all group members. The theoretical prediction of this situation is that subject will not invest any part of their endowment to the public account. The experimental evidence is contrary to the theoretical prediction.

The main references that have inspired the present work are Kurzban and Houser (2005) experiment and Alexander and Fotini's (2011) paper. Specifically, the Kurzban and Houser's methodology for measuring altruistic behavior is compared with a method that has been developed using Alexander and Fotini's idea that the personal expenditure undertaken by a punisher is useful for bringing out the magnitude of the punisher altruism. Both methodologies classify subjects as altruistic or no altruistic. Moreover, a questionnaire has been created in order to collect some demographic characteristics of the sample: age, level of studies and gender. Both methodologies have been applied to the sample and results has been contrasted.

Results show that both methodologies present similar percentages of subjects classified as altruistic. Nevertheless, methodology used by Kurzban and Houser (2005) seems less permissive than the methodology from the idea commented by Alexander and Fotini (2011).

In addition, results show that there are not gender differences in altruistic behavior. Moreover, it is found that the level of studies has an effect in how altruistic a subject is, and finally, results reveal that cooperators usually have altruistic motivations.

The state of the art is presented in the next section and the methodology used is described in the third section. In section IV, five hypotheses are commented, and the survey design is detailed in the section V. Section VI includes the data analysis and results and the final section concludes. Some tests used are included in the appendix A and the main screenshots of the survey are contained in the appendix B.

State of the art

In this section we review the literature about the experiments of public good game and some theories and experiments that try to explain why there is a deviation of the theoretical prediction from free-riding, mostly all theories that suggest no-monetary reasons.

Brañas-Garza and Cabrales (2015) define as a basic version of Public Good Game a situation characterized by the following factors: subjects are assigned in groups of *N* members. They do not know the other members of the group and they usually can not communicate with them. Each member has an initial endowment of T tokens and she must allocate her endowment between a private project and a public project, they usually decide at the same time. Each token invested in the private project produces M monetary units for the subject and 0 for the other members of the group. Each token invested in the public project produces V monetary units for all members of the group. The total payoff of the subject is M for each token invested by himself in the private project plus V for each token invested in the public account, considering his contribution and contributions of other members. If V<M, there is a Nash equilibrium, anyone should invest tokens in the public project. Nevertheless, subjects usually do not operate following the Nash prediction.

Since the earliest experiments of estimation of the demand for public goods, a breach of the dominant strategy appears, players contribute more than 0% of their endowment in the public good. These experimental results are against one of the most accepted ideas, the free-riding hypothesis exposed by Hardin (1968).

This deviation of the Nash equilibrium has been repeated testing many different treatments: one-shot games [Bohm (1972), Ledyard (1995)], repeated games[1] [Andreoni (1988), Croson (1996), Keser and Frans van Widen (2000)], with communication (Duffy and Feltovich, 2000), with heterogeneous endowment (Keser et al., 2014), etc.

However, there are some studies in which players free-ride, for instance, when all the players are students of economics (Marwell and Ames, 1981).

One of the theories that tries to explain the positive level of contribution of the players is that in a repeated context, the subjects learn along the experimental session, they need experience. Andreoni (1988) tested the experience hypothesis with a repeated public goods game with an unexpected restart. The participants played ten rounds of the game, and then the experiment designer told them to play again 10 more rounds. Nevertheless, they only played three bonus rounds because they considered enough to test the experience. The hypothesis was that if the contribution in the bonus rounds was different than in the last rounds before the restart, experience can not explain decay of contribution. The result of this experiment is that in the first bonus round the contribution is as higher as the first contribution and the third bonus round shows similar contributions as the tenth round. The restart affected the behavior, so experience is not the only factor that affects the decay. Moreover, we can conclude that experience accelerates the decay in repeated games.

Crosson (1996) repeated the experiment of Andreoni (1988) but with ten extra rounds. The restart effect was observed again, the enlarge in mean contribution, at the starting point of the second ten rounds. This result confirms that experience is not enough to explain the contributions of the players.

Moreover, Marwell and Ames (1981) realized a one-shot design with experienced subjects (experiment 5), they already played in a one-shot public goods game experiment before. The results of the experiment were like one-shot experiments with equivalent treatment and inexperienced players.

The absence of free-riding can not be explained by inexperience, results in repeated games suggest that there is something else that affects behavior of subjects to contribute

[1] Provision decay during the repeated game toward 0; see Andreoni (1988).

more than 0, in addition, results in one-shot experiments with experienced subjects are similar to experiments with inexperienced subjects.

Otherwise, Andreoni (1988) tries to test other theory: strategic decisions. The theory suggests a positive level of contributions appears when subjects can play strategically, namely, they try to coordinate with the other participants of the experiment. To test this hypothesis Androeni designs two treatments; in the first one, players are divided in four groups of five people and they play and play ten rounds of the public good game with the same group, in this treatment named partners, players can play strategically. In the second treatment, strangers, groups change every round, so they can not play strategically. If subjects in treatments with partners matching contribute more than subjects in random matching, it will mean than strategic behavior will explain the overcontribution of the players. Results show that strangers give more than partners, so Andreoni rejects the strategic decisions theory.

Nevertheless, Crosson (1996) replicated the partners and strangers design and the results were completely opposite. Results show that partners contribute more than strangers. Keser and Frans van Widen (2000) considered that the reason controversial results may be that experiments are based on a small number of experimental sessions. They performed a similar experiment with many more sessions, and they concluded that partners contribute more than strangers.

Strategic behavior can explain a part of the positive level of contributions. Subjects contribute more in no-random matching. However, strategic behavior can not explain why subjects do not free ride in random matching

Another theory that tries to explain the behavior of the players is reciprocity. Rabin (1993) consider that in addition to their own self-interest, people care about social goals. The behavior of people depends on the behavior of their peers, they will be motivated to benefit people who helps them, and they will be motivated to hurt those who hurt them.

To test reciprocity, Kurzban and Houser (2001) use a design from Andreoni (1995) and add information about the current contribution level. Participants in half of the groups could see the highest contribution to the group and the participants in the rest of the groups could see the lowest contribution to the group. They ran a regression of the contributions on the value of the information, in order to evaluate reciprocal behavior of players. They conclude that there is a significant relationship between the information observed at the

end of a round and the contributions of the players. People in voluntary contribution mechanism will contribute more when they expect that other participants will contribute.

Moreover, Kurzban and DeScioli (2008) realize a similar design, but now participants could choose the data they consider: lowest contribution, higher contribution or mean of contributions. The regression they ran shows similar results than Kurzban and Houser mentioned, even when player must pay for the information.

Literature about reciprocity in the linear public good game shows that subjects will contribute if they expect that the other subjects will contribute. Moreover, they will not contribute if they foresee that the other players will not contribute.

On the other hand, there are some explanations that suggest that subjects have nonmonetary motivations to walk away from free riding. First, the altruism effect (Ledyard, 1995) evaluates the additional benefit a subject acquires from increasing the payoff to other subjects. And second, the warm-glow effect (Andreoni, 1988) evaluates the additional benefit a participant acquires from just the fact of contributing a unit of his income.

Palfrey and Prisbrey (1997) carried an experiment to test the altruism effect and the warm-glow effect. They designed an experiment where each participant was in a 4 people group and they play four sequences of ten periods. The value of the private good changed every period, it was randomly assigned for each subject. The value of the public good, *V*, changed after de second sequence, the first and second sequences had the same value of the public good and the last sequences had the same value, but different from the first value. They estimated a probit model where the dependent variable was the binary investment decision and independent variables were a constant term, the value of the public good and the difference between the value of the private good and the value of the public good. Palfrey and Prisbrey considered that the altruism effects were present if contributions get bigger with the public good value, other factors ceteris paribus. The coefficient of the value of the public good was not significantly different from zero, thus there was not confirmation for an altruism effect. On the other hand, they considered that warm-glow effects appear when contributions increase with a bigger difference between the public good value and the private good value, other factors ceteris paribus. The coefficient of the difference between the value of the private good and the value of the

public good was deeply significant and positive, thereby there is powerful evidence for a warm-glow impact bringing about voluntary contribution.

Regarding altruism, Brandts and Schram (2001) designed an experiment with 10 successive periods. In each period, twelve subjects were allocated to three groups of four people and they answered how to divide their endowment for 10 different scenarios, in which the outcome of the public account was placed fixed but the retribution of the private account varied, so they extract information for heterogeneous marginal rates of information. They ran different treatments, for instance, partners vs strangers, full information vs partial information, etc. Furthermore, they designed a test to classify subjects as individualist or cooperators. They considered that warm-glow benefits and altruistic behavior are independent of other subjects' behavior, thus if behavior of cooperators is influenced by other participants, it will signify that nonmonetary motivations are not enough to explain positive contributions. Brandts and Schram use 3 evidences to argue interdependence of participants behavior. First, they measure concentration of contributions with 2 inequality indices, Theil coefficient and Gini coefficient, they observe peculiar Gini and Theil coefficients in the last period of partners matching, so they conclude that there is concentration of contributions in specific groups. Second, they compare the gains between those that the test had classified as individualist and those that the test had classified as cooperators, they observe that cooperators earn more in the last period. And finally, they analyze the differences of contributions of individualist and cooperators for all possible combinations of treatments effects, they observe that full information and the heterogeneous treatment stimulate more contributions in patterns matching than in strangers matching, cooperators can find other cooperators in their groups. All 3-analysis show that behavior of other participants influences the behavior of the subjects. Thus, Brandts and Schram after the analysis suspect that warm glow and linear altruism being the entirely variety of other-regarding behavior, this result is the opposite conclusion of Palfrey and Prisbrey.

In this respect, Goeree, Holt and Laury (2002) arranged an experiment to test altruism in one-shot situations. They considered that an increment in the marginal value of the public good has two effects that drives altruism: it reduces the net cost of contribute and raises the benefit to others. They designed an experiment with 10 different treatments, each treatment was a one-shot public good game and they varied the internal return of the public good (Cost of making contribution), the external return of the public good (Increase

the benefit of other participants) or the group size. They use standard maximum-likelihood techniques to test the relative importance of altruism, they estimate different models and then they tested which model fit with the data. A linear altruism model showed the importance of the errors of subjects and it measured the altruistic behavior of participants, an individual was willing to give up 10 cents to provide 1$ more to someone else. However, they ran other estimations, they used warm-glow model of Palfrey and Prisbrey (1997) and they measured warm-glow effect with likelihood techniques, then they observed that the results fit worse with data. When they combined in the same model altruism and warm-glow, results indicated that warm-glow was not significant. So, they conclude that a change in the external return and the group size display some altruism. Nevertheless, they consider that altruism is not linear, so they ran a Cobb-Douglas model of altruism, which it was significant too, moreover, it fit with data better than the linear model and fit better with data of other experiments. Later, this model of altruism and this maximum likelihood technique have been used to estimate altruism parameter in a few more papers, for instance, Laury and Taylor (2008) use this estimation of altruism and compare altruistic behavior in a public good game experiment and altruistic behavior in a natural occurring public good. Anderson, DiTraglia and Gerlach (2011) use the same methodology to realize a comparison of altruism of U.S. and Czech subjects, moreover, they show gender differences.

Subsequently, Kurzban and Houser (2005) carried out an experiment in which participants were distributed in groups of 4 people. They played an indeterminate number of rounds; game lengths were generated randomly, and it was unknown to subjects. The first round consisted of all players at the same time making an allocation to the two typical accounts, then, in the next round one player of each group was informed of the current aggregate contribution to the group exchange. Suddenly, that player was given the option to change his allocation to the two accounts. The game proceeded round by round until the game concluded at a point unrevealed to the subjects. They informed every player that they would had at least one opportunity to change their contribution. They used a statistical-type classification algorithm to classify each subject. Their procedure to label was the linear conditional-contribution profile of each subject. Kurzban and Houser designated each linear conditional-contribution profile as the outcome of an ordinary least-squared regression of each subject contribution decisions on the mean contribution that he observed immediately before re-allocating his contribution decision. Algorithm classified

20% of subjects as free-riders, 13% as cooperators and 63 as reciprocators. Moreover, they observed substantial differences in decisions among these 3 types of behavior.

On the other hand, Alexander and Fotini (2011) consider that altruism can be measured in the public good game context including the opportunity to sanction other subjects. The sanctions must be costly for the punisher, so, the personal expenditure undertaken by the punisher guarantee that penalty are credible and aid to bring out the magnitude of the players altruism: the more of her endowment she employ to boost group wide contributors, the higher her altruism as delineated and calculated by this procedure. Nonetheless, they didn't realize any analysis in that paper using that methodology.

Literature picks up different ways to estimate altruism and altruistic behavior. However, there is a huge amount of results and some of them are controversial. The following section will describe the methodologies used in this dissertation for compare these different ways to estimate altruistic behavior.

Methodology

In this section, both methodologies used to test altruism are explained. We denominate the first procedure as *linear conditional-contribution profile* methodology and the second procedure as *personal cost undertaken by the punisher* methodology. Moreover, the classification of the sample from the questionnaire is commented.

Regarding of linear conditional-contribution profile methodology, Kurzban and Houser (2005) used a linear conditional-contribution profile to classify subjects. They specified a linear conditional-contribution profile as the result of an ordinary least-squares regression of each subject contribution on the average contribution that they viewed shortly before allocating their endowment. They considered subjects as free riders if and only if their linear conditional-contribution profile diagram remains everywhere below 25 percent of the endowment. On the other hand, they recognized contributors as cooperators if and only if their linear conditional-contribution profile graph was over 25 percent during all its path. In addition, they classified subjects as reciprocators if the chart of their linear conditional-contribution profile has a positive slope and spreads both above and below the 50 percent. This methodology is replicated for the data of the first treatment.

In relation to personal cost undertaken by the punisher methodology, Alexander and Fotini (2011) considered that altruistic behavior can be measured with the propensity of the subject to spend money punishing with the aim to increase the group contribution for the following rounds. They did not postulate a norm to classify subjects. In this analysis, we consider this methodology and we classify a subject as an altruist when he spends more than 5% of his endowment to impose sanctions. We measure the percentage of endowment used to punish each round of the second treatment and we classify subjects following this gauge of judgment.

Moreover, we classify subjects using the questionnaire by gender and by their level of education. We allocate subjects as individuals or cooperators, following the questionnaire from Brandts and Schram (2001), subjects that evaluate the following statement "In these situations, investors should cooperate with the objective of achieve everybody more money" with 1 or 2 are considered individualists, those subjects that evaluate the statement with 6 or 7 are considered cooperators. Subjects with any other evaluation are not classified.

Hypothesis

We consider that results from our survey, using procedures and methodologies described above, will fit the next hypothesis:

First hypothesis. Results using linear conditional-contribution profile methodology should classify roughly 20% of the sample as free-riders, 17% of the sample as cooperators and 63% as reciprocators.

Our results should be similar as results from Kurzban and Houser (2005) because we use the same procedure.

Second hypothesis. Respect the questionnaire, roughly 23% of the sample is classified as individualists, 23% of the sample as cooperators and 54% remain unclassified.

We replicate the same procedure that Brandts and Schram (2001) in their questionnaire, therefore, results of this classification should be similar.

Third hypothesis. Subjects classified as altruistic using linear conditional-contribution profile methodology should be classified as altruistic using personal cost undertaken by the punisher methodology and vice versa.

Both methodologies measure altruistic behavior, so results between both procedures should be correlated.

Fourth hypothesis. Subjects classified as cooperators using the questionnaire from Brandts and Schram (2001) should be classified as altruist by at least one of the 2 procedures.

It seems reasonable to consider cooperators as those who want everyone to be comfortable, so cooperators should be related with an altruistic behavior.

Fifth hypothesis. There is not difference between male and female in terms of altruistic behavior.

Goeree, Holt and Laury (2002) realized an analysis of altruistic behavior and they did not observe difference between male subjects and female subjects, it should be identical in the analysis realized in this dissertation.

Of course, a survey is not the best method for testing this hypothesis. Moreover, the subject does not have a monetary incentive answering the survey, so the motivation of their responses may not be realistic.

Survey Design

In this section, the layout of the survey is described. This survey was made using the application Google Forms from Google. The survey consists of 24 questions and it is divided in 4 sections.

The first section of the survey introduces the instructions of the survey and then presents the first question. Subject must choose a random number between 0 and 9, both included. This choice determines the current aggregate contributions to the group exchange in the following questions. In Kurzban and Houser (2005) the current aggregate contributions to the group exchange was the summation of the contributions of the other subjects so this summation was different for each subject, nevertheless, in a survey there

are not other subjects. The objective of this first question is to emulate heterogeneity for the current aggregate contributions to the group exchange.

The second section consists of 6 questions and it is a version of a public good game. Subject is informed that he is part of a group with other 3 members and every member of the group have an endowment of 50 tokens. In the first question subject must allocate his endowment to 2 different accounts:

-Account individual exchange: for each token invested, the subject earns 10 Tokens and the other members of the group earn 0 tokens.

-Account group exchange: for each token invested, all members of the group earn 5 Tokens, in addition, subject earn 5 Tokens for each token invested by other members of the group.

Then, subject is informed about the current aggregate contributions to the group exchange, this value is determinate by his choice in the first section. The second question allows the subject to change his initial allocation with this new information. These 2 questions are repeated 2 more times. The objective of this section is to generate data for an analysis of altruism using the linear conditional-contribution profile methodology.

The third section consists of 12 questions and it is a version of a public good game again. Subject is informed that he is part of a group with other 3 members and every member of the group have an endowment of 50 tokens. In the first question subject must allocate his endowment to 2 different accounts:

-Account individual exchange: for each token invested, the subject earns 10 Tokens and the other members of the group earn 0 tokens.

-Account group exchange: for each token invested, all members of the group earn 5 Tokens, in addition, subject earn 5 Tokens for each token invested by other members of the group.

Then, subject is informed about the current individual contribution to the group exchange of each member of the group. The next three questions allow subject to punish the other 3 members of the group. The subject can give up a voluntary number of tokens and the payoff of the member punished is reduced two times this number of tokens. These

4 questions are repeated 2 more times. The objective of this section is to generate data for an analysis of altruism using the personal cost undertaken by the punisher methodology.

The last section consist of 4 questions and it is a post-survey questionnaire. In the first question subject must to evaluate the veracity of the next affirmation on a seven-point scale “In these situations, investors should cooperate with the objective of achieve everybody more money.” That question was mimicked from Brandts and Schram (2001). Then the subject asks a question about gender, another about age and the last question is about his level of studies. The objective of this section is to generate data for classify subjects.

Appendix B includes the main screenshots of the survey in Spanish.

Data analysis and Results

This section is focused on describing the main results of the survey’s data analysis. First, the main details of some descriptive statics are outlined, then an analysis of the public good game is carried out and, finally, processes submitted in the *Methodology* section to measure the altruistic behavior are applied.

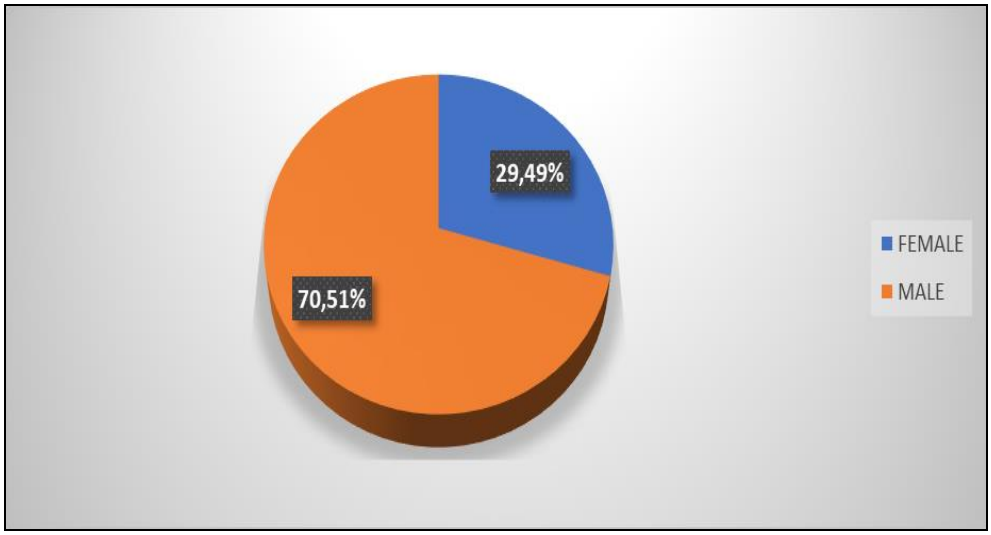
The survey was answered online, and it was made accessible using Google Forms sharing options. In detail, the survey was published on the 14th of April and it was available for one week. A total of 78 responses were registered.

The Sample

The aim of this section is to descrive the charasteristics of the sample. Sample is classificated into three criteria from the socio-demographic questionnarie: age, gender and level of studies.

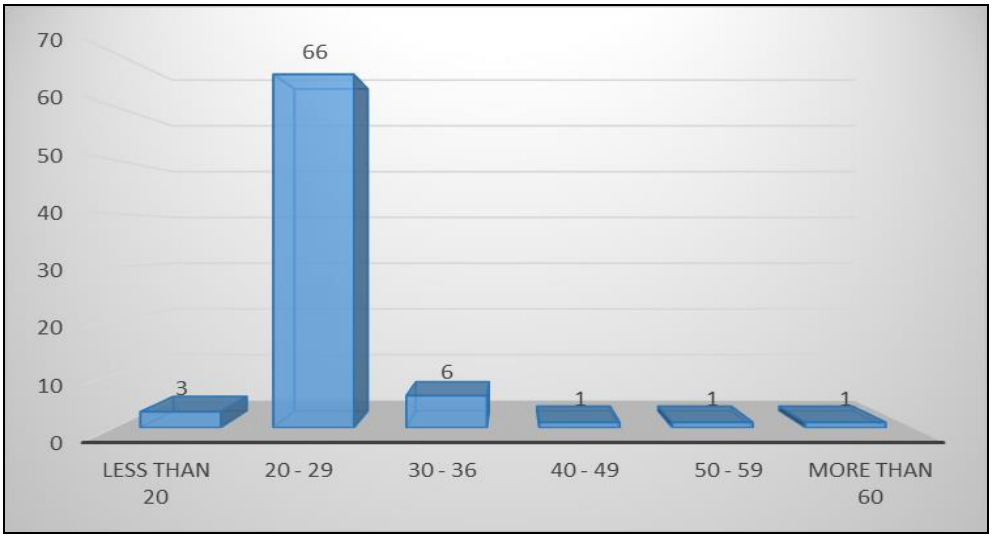
Figure 1 is a pie chart that shows the percentages of the distribution of the sample by gender. The sample consists of 23 women and 55 men. Thus, the number of male subjects is vastly greater than that of female subjects.

Figure 1: Distribution of the sample by gender



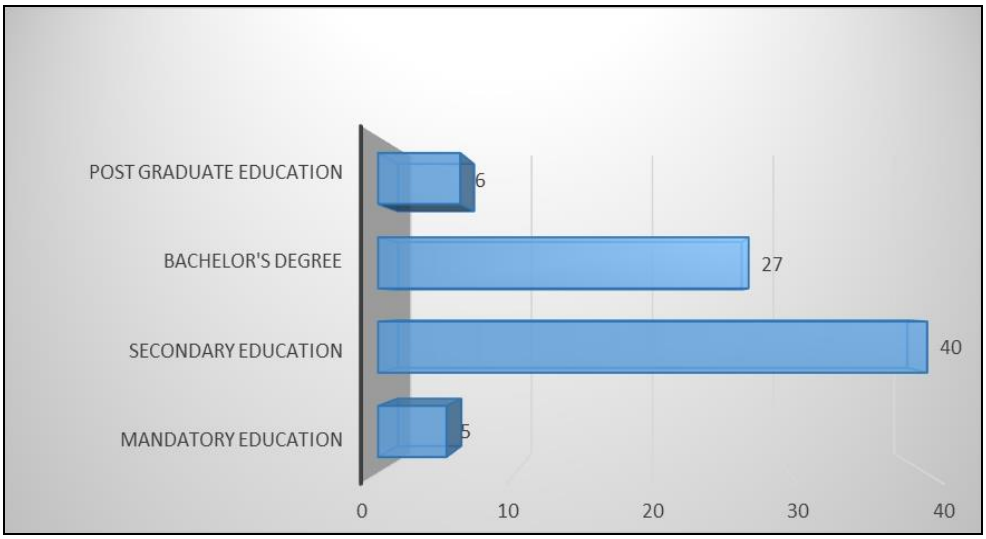
Regarding age distribution. Figure 2 is a frequency distribution of the ages of the subjects. Observe that the main part of the sample is between 20 and 29 years old, roughly 85% of the sample. Each of the other groups represents less than the 7% of the sample

Figure 2: Distribution of the whole sample by age.



In the chart graphic presented as Figure 3, it is showed the distribution of the sample by the level of studies completed. 51% of the sample has attained secondary education, 35% of the subjects attained a Baechlor's degree and 8% of the subjects has postgraduate education. Only 6% of the sample leaved studies after mandatory education.

Figure 3: Distribution of the sample by level of studies

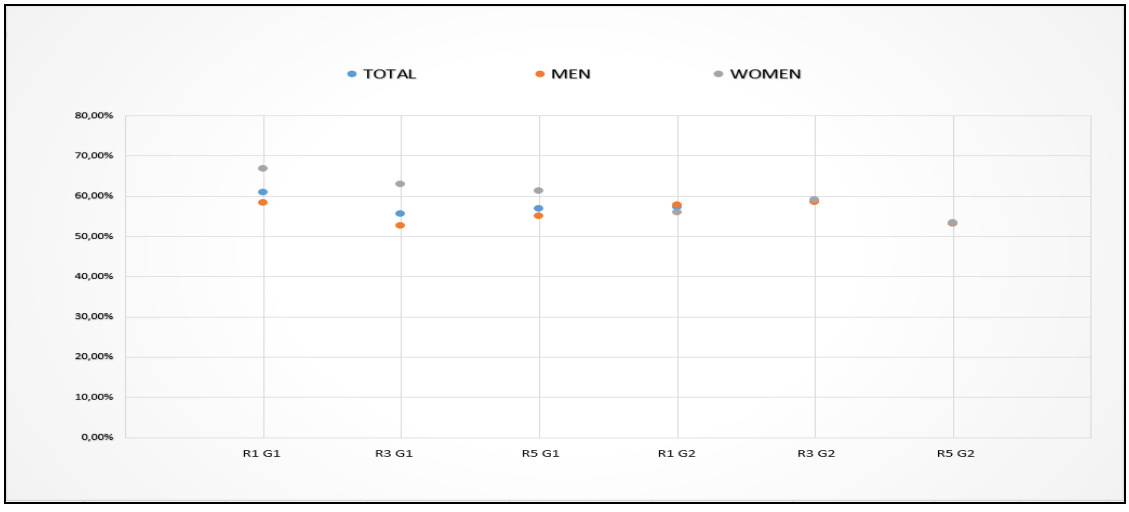


Public Good Game

In this section, we carry out an analysis of the Public Good Game. We can consider the odd rounds of each game as 6 different one-shot Public Good Games.

Figure 4 presents the data for average investment in the group exchange for each one-shot public good game in terms of the percentage of the endowment. It shows that the average of the investment in the public account is around to the 55%-60% of the endowment. In other words, the subject contributes more than half of his/her endowment to the group exchange, on average.

Figure 4: Average investment in the group exchange



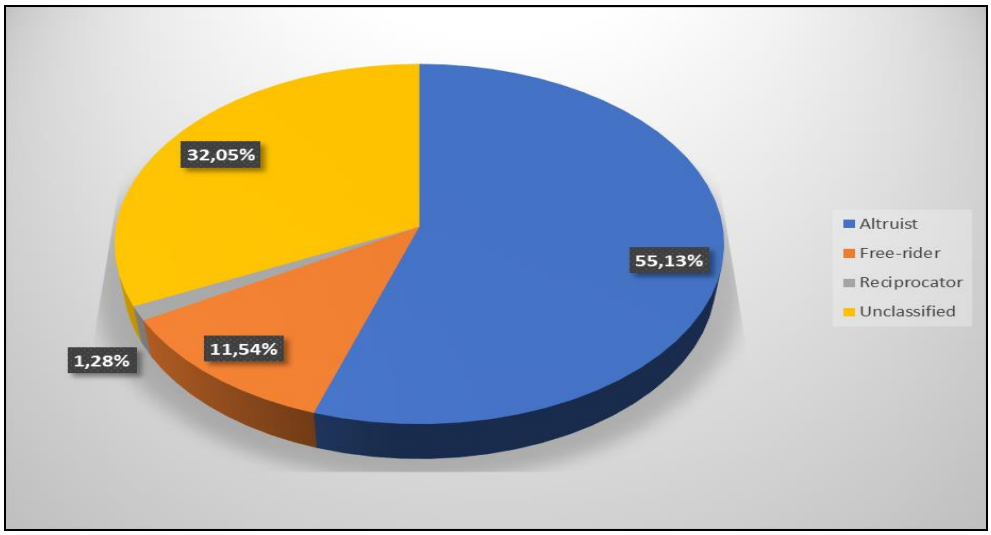
Players contribute more than 0% of their endowment to the group exchange, for this reason, this result is in line with the previous public good game experiments in the literature, there is a breach of the dominant strategy, this fact was commented in the section “State of the art”.

Altruism

In this section, we will comment the results of applying the procedures from the section *Methodology* to the data from the survey.

Regarding the linear conditional contribution profile methodology, the gauge of judgment classifies 43 subjects as Altruist (55% of the sample), 9 subjects as Free-riders (12% of the sample), 1 subject as reciprocator (1% of the sample) and 25 subjects remain unclassified (32% of the sample). These results are presented in figure 5.

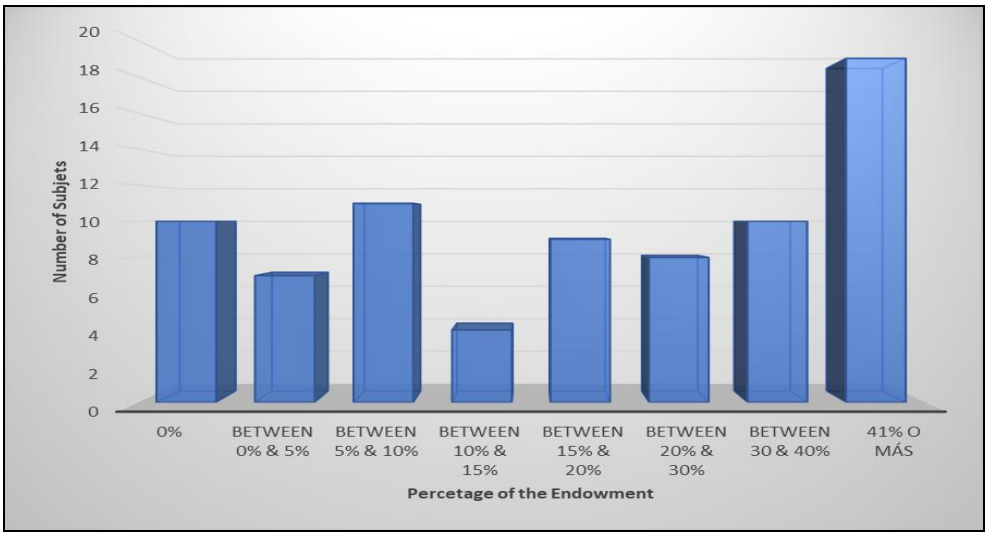
Figure 5: Classification of the sample using the linear conditional-contribution profile methodology.



Results differ greatly from the results from Kurzban and Houser (2005) experiment. For this reason, we can reject the first hypothesis.

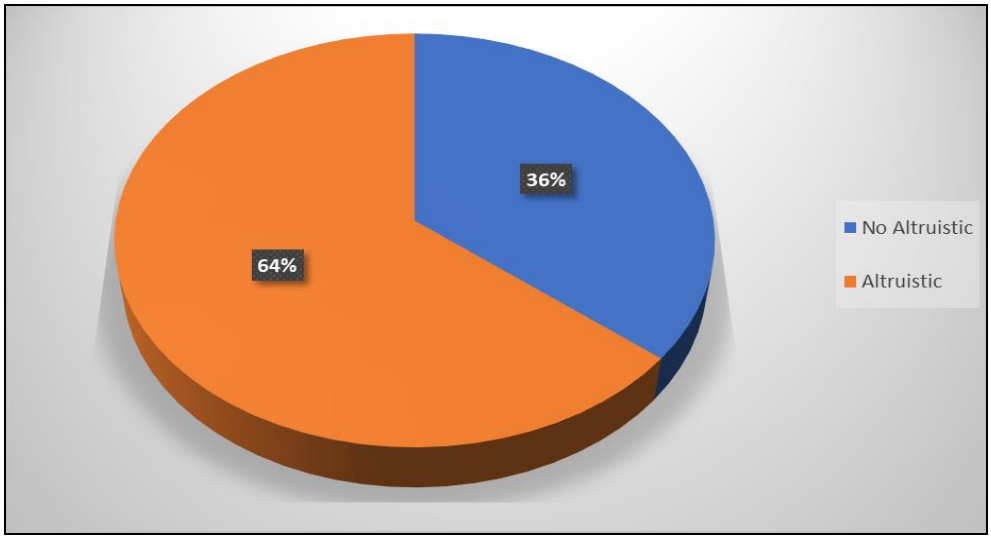
Concerning the personal cost undertaken by the punisher methodology, we calculate the percentage of the endowment that subjects use for punishing the other subjects. Figure 6 is a chart graph that presents the amounts that subjects are willing to give up for increase the group contribution for the following rounds and the number of subjects for each percentage.

Figure 6: Willingness of the subjects to give up part of their assets in order to punish.



The gauge of judgment used for this methodology (A subject is altruist when he spends more than 10% of his endowment) classifies 50 subjects as altruist and 28 subjects as no altruist. In other words, 64% of the sample is willing to spend 10% of their endowment to increase the group contribution for the following rounds. Figure 7 presents this statistic.

Figure 7: Classification of the subjects using the personal cost undertaken based on the punisher methodology



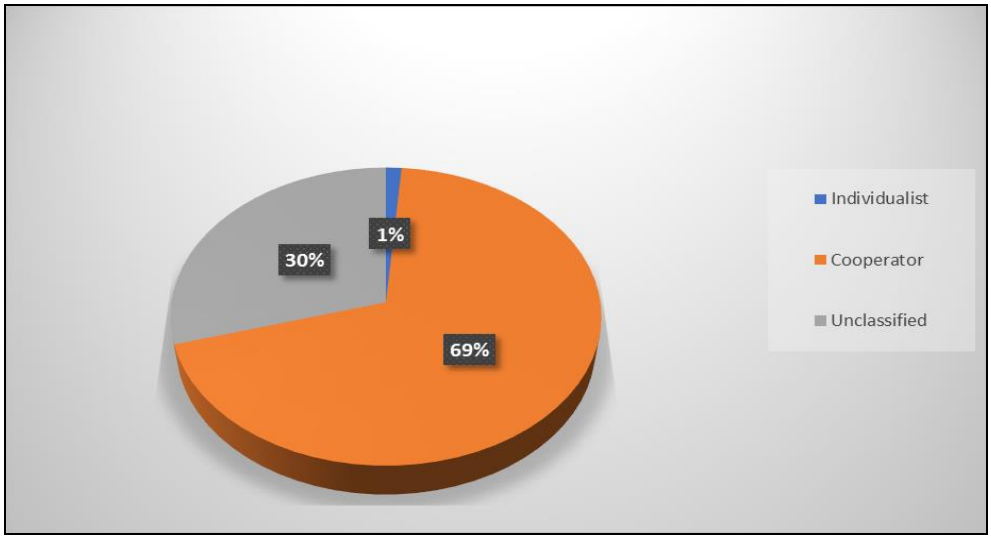
Comparing both methodologies, 29 (64.44%) of the subjects classified as altruist by the linear conditional-contribution profile methodology are classified as altruist by the personal cost undertaken by the punisher methodology. Likewise, 58% of the subjects classified as

altruist by the personal cost undertaken by the punisher methodology are also classified as altruist by the linear conditional-contribution profile methodology.

Hence, it seems reasonable not to reject the third hypothesis. Subjects that were allocated as altruist by one of the methodologies are probably also allocated as altruist by the other methodology.

On the other hand, the questionnaire from Brandts and Schram (2001) classifies 54 subjects as cooperators, 1 as individualist and 23 remain unclassified.

Figure 8: Classification of the sample following the questionnaire from Brandts and Schram (2001).



These results are strongly differents from the percentages of the Brandts and Schram (2001) experiment. For that reason, we can reject the second hypothesis, results of this dissertation are not like the Brandts and Schram (2001) classification.

Moreover, for testing the fourth hypothesis, we compared the results of the linear conditional contribution profile methodology and the personal cost undertaken by the punisher methodology for all 54 cooperators. We observed that 83.33% of the cooperators are classified as altruist by at least one of both procedures. Fourth hypothesis seems acceptable. We can confirm that a cooperator wants everyone to be comfortable and it is closely related with altruistic behavior.

Afterwards, we compare altruistic behavior between genders. The following four figures presents the percentages of sample classified as altruist by the personal cost undertaken

by the punisher methodology and by the linear conditional contribution profile methodology applied for men and women.

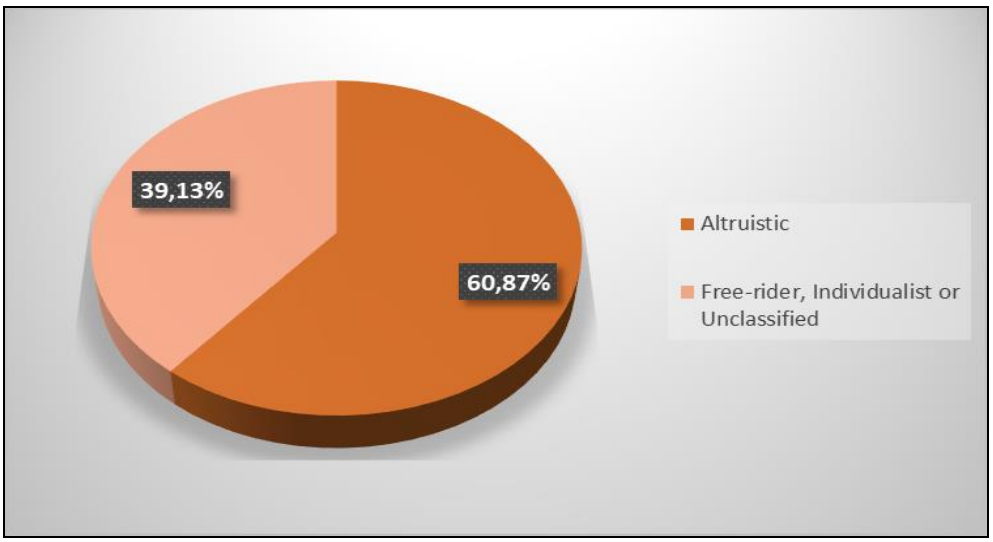
First, we observe that the personal cost undertaken by the punisher methodology classifies 60.87% of women and 52.73% of men as altruist.

Secondly, we note that the linear conditional contribution profile methodology distributes 73.91% of women and 60% of men as altruist.

On the other hand, the amounts that subjects give up for punishing can be considered as a measurement of altruism. For testing gender differences, we compare these amounts between men and women. Samples does not come from a normally population, so we use a Mann Whitney U test[2]. Using this test, we can confirm that there is no difference between men and women in the willingness to spend part of their endowment for punishing, considering a significance level of 0.05.

In both methodologies, women have a slightly higher percentage of people altruist than men. Nevertheless, results of the Mann Whitney U test in the Appendix A suggest that this slightly difference is not statistically significant. Thus, we can not reject the fifth hypothesis, we consider that the behavior of women is as altruistic as the behavior of men.

Figure 9: Classification of women as altruistic or no altruistic using the linear conditional contribution profile methodology.



[2] Tests of Normality and Mann Whitney tests are presented in the appendix A

Figure 10: Classification of men as altruistic or no altruistic using the linear conditional contribution profile methodology.

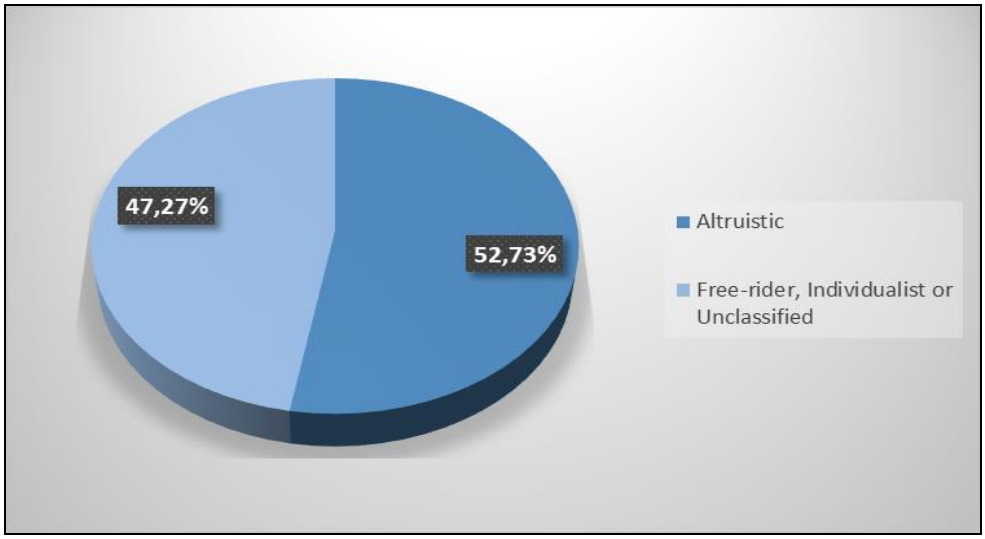


Figure 11: Classification of women as altruistic or no altruistic using the personal cost undertaken by the punisher methodology.

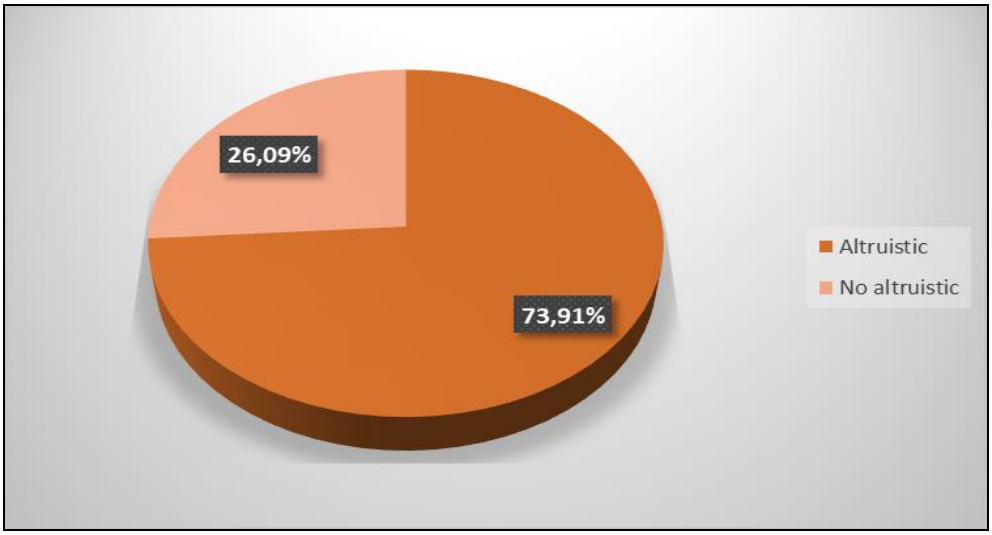
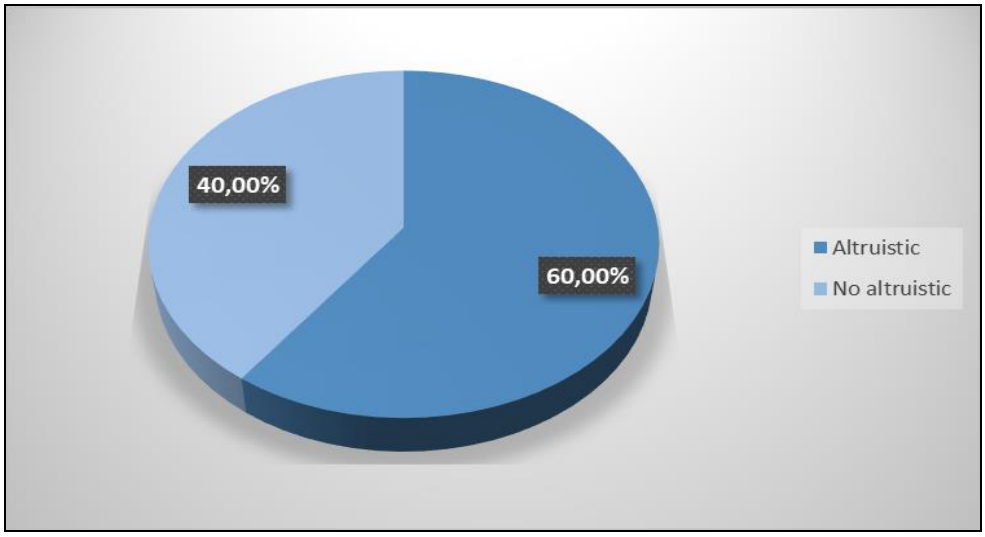


Figure 12: Classification of men as altruistic or no altruistic using the personal cost undertaken by the punisher methodology.



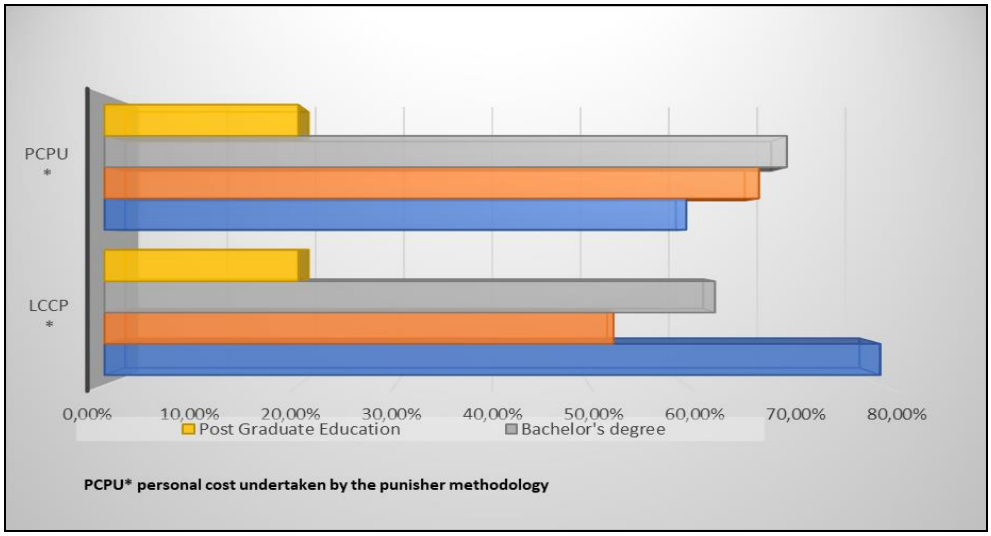
Furthermore, it is considered the possibility of the level of studies having an effect in how altruistic a subject is. Figure 13 presents the percentage of subjects classified as altruist for each one level of studies. Percentages of subjects classified as altruist for subjects that studied a bachelor's degree, subjects that studied secondary education and subjects that only studied mandatory education are similar, roughly 50%-60% of all subjects. However, both methodologies classify as altruist 20% of subjects that studied post graduate education.

Moreover, we compare the amounts that subjects with post graduate education give up for punishing with the amounts that the other subjects give up for punishing. We use a Mann Whitney U test because distribution of both samples is not normal[3]. Using Mann Whitney U test presented in appendix A, we can confirm that there is difference between subjects with post graduate education and subjects with lower level of studies in the willingness to spend part of their endowment for punishing, considering a significance level of 0.05.

In other words, altruistic behavior is more common when subject studied less than post graduate education. Subjects with the higher level of education presents lower percentage of altruistic behavior, they are almost never altruistic.

[3] Tests of Normality and Mann Whitney tests are presented in the appendix A

Figure 13: Percentage of subjects classified as altruist for each level of studies.



We considered to carry out an analysis of the influence of the age for altruistic behavior, nevertheless the chararteristics of the sample are not suitable. Sample is not heterogeneous enough for this analysis.

Data, results and treatments are available on the following link:

https://drive.google.com/drive/folders/1BA-kTLJrBd1cMgo1dV18aeHukuhYiNzS?usp=sharing

Conclusions

In this section the main conclusions of the dissertation are commented, the limitations and problems of the survey and further research options.

Altruistic behavior is one of the most consolidated methods in the literature on public good game experiments in explaining the deviation from free riding. Some papers show nonmonetary motivations in the behavior of subjects when they face a public good situation. Recently, various methodologies and procedures were applied for testing and estimating altruistic motivations of subjects. In general terms, most of the methodologies used consider that a part of the subjects of the experiments has altruistic motivations in their decision making. Nevertheless, few dissertations consider that altruistic behavior is not significant enough, and experience and reciprocator behavior are considered as more correct explanations.

In this dissertation, a survey has been accomplished with the aim of comparing two methodologies to estimate altruistic behavior in the context of the Public Good Games. The survey was made up for two Public Good Games. In the first one, subjects could change their allocation after observing the amount of contributions of the group. In the second game, subjects could punish the other members after observing each of their contributions. Then two procedures to estimate altruistic behavior were applied. The first one based on Kurzban and Houser (2005), it classifies subjects as altruist depending the result of an ordinary least-squares regression of each subject contribution on the average contribution that they viewed shortly before allocating their endowment. The second one, developed from a consideration in Alexander and Fotini (2011). It classifies subjects as altruist depending the personal expenditure undertaken by a subject for punishing other subjects.

Results show that in this survey the percentage of subjects classified as altruist by the linear conditional-contribution profile methodology is higher than the percentage of subjects classified as altruist from Kurzban and Houser (2005). Subjects did not have a monetary incentive, for this reason, subjects probably acted more altruistically.

Moreover, 55.13% of the subjects were classified as altruist by the linear conditional-contribution profile and 64% of the subjects were classified as altruist by the personal cost undertaken by the punisher methodology. It seems clear that the second methodology is more permissive than the first one.

Furthermore, most subjects considered as cooperators by the Brandts and Schram (2001) classification were classified as altruist by at least one methodology. It can be concluded that cooperators often have altruistic motivations in their behavior.

Regarding gender, the percentage of women classified as altruist is a little higher than the percentage of men, but this difference is not statistically significant. Behavior of women is not more altruistic than behavior of men.

Regarding the level of studies has an effect in how altruistic a subject is. People with postgraduate education presented percentages of subjects classified as altruist considerably lower than the percentage presented by the other subjects. The difference is statistically significant.

The survey has been a source of problems for study the altruistic behavior. First, there was not economic incentives for subjects, for this reason, probably subjects present a more altruistic behavior. Moreover, sample was not big enough. There were 78 answers, it is a small number for a complete study the altruism of subjects. The last problem was that ages of subjects were not heterogeneous enough, for this reason, the possibility of the age having an effect in how altruistic a subject is was not analyzed.

Finally, some new alternatives of further research can be putting into action the methodologies used for this survey into a controlled experiment, with the aim of control the sample and using monetary incentives for motivate the decisions of the subjects. Moreover, another new alternative of research could be adding the methodology used in Goeree, Holt and Laury (2002) with the objective to compare a new methodology with both procedures studied in this dissertation.

References

Alexander, M. and Fotini C. 2011. Context Modularity of Human Altruism. *Science,* 334 (6061), pp.1392–1394.

Anderson, L.R., DiTraglia, F.J. and Gerlach, J.R. 2011. Measuring altruism in a public goods experiment: a comparison of U.S. and Czech subjects. *Experimental Economics,* 14. pp.426–437.

Andreoni, J. 1988, Why Free Ride? *Journal of Public Economics,* 37, pp.291-304

Andreoni, J. 1995. Cooperation in public goods experiments Kindness or confusion *American Economic Review,* 85, pp.891-904.

Brañas-Garza, P. and Cabrales, A., 2015. *Experimental Economics*. New York: Palgrave Macmillan.

Brandts, J. and A. Schram 2001. Cooperation and noise in public goods experiments: applying the contribution function approach. *Journal of Public Economics*, 79, pp.399-427.

Bohm, P. 1972. Estimating demand for public goods: An experiment. *European Economic Review*, 3(2), pp.111-130.

Croson, R. 1996. Partners and Strangers Revisited, *Economics Letters,* 53, pp.25-32

Goeree, J., Holt, C.A., and Laury, S. 2002. Private Costs and Public Benefits: Unraveling the Effects of Altruism and Noisy Behavior. *Journal of Public Economics,* 83, pp.257-278.

Hardin, G., 1968. The tragedy of the commons, *Science,* 162, pp.1243-1248.

Keser, C., and Van Winden, F. 2000. Conditional Cooperation and Voluntary Contributions to Public Goods. *The Scandinavian Journal of Economics,* 102(1), pp.23-39.

Keser, C., Markstädter, A., Schmidt, M., and Schnitzler, C. 2014. Social cost of inequality - Heterogeneous endowments in public-good experiments. *Center for European, Governance and Economic Development Research - cege Discussion Papers,* N. 217. pp.1–28.

Kurzban, R., and Houser, D. 2001. Individual differences and cooperation in a circular public goods game. *European Journal of Personality*, 15(S1) pp.S37–S52.

Kurzban, R., and Houser, D. 2005. Experiments Investigating Cooperative Types in Humans: A Complement to Evolutionary Theory and Simulations. *Procedings of the National Academy of Sciences of the United States of America,* 102(5) pp.1803-1807

Kurzban, R. and DeScioli, P. 2008. Reciprocity in groups: information-seeking in a public goods game. *European Journal of Social Psychology*, 38 pp.139-158.

Laury, S.K. and Taylor, L.O., 2008. Altruism spillovers: are behaviors in context-free experiments predictive of altruism toward a naturally occurring public good?, *Journal of Economic Behavior & Organization,* 65 (1), pp.9–29.

Ledyard, J. O. 1995. Public goods: A survey of experimental research. In J. A. Kagel and A. E. Roth (Eds.), *Handbook of Experimental Economics* (pp. 111–194). Princeton, NJ: Princeton University Press.

Marwell, G. and Ames, R. E. 1981. Economists free ride, does anyone else? Experiments on the provision of public goods, *Journal of Public Economics,* 15 (3), pp.295-310.

Palfrey, T.R. and Prisbrey, J.E. 1997. Anomalous behavior in public goods experiments: How much and why? *American Economic Review,* 87, pp.829-846.

Rabin, M. 1993. Incorporating fairness into game theory and economics. *American Economic Review*, 83, pp.1281-1302.

Zelmer, J. 2003. Linear Public Goods Experiments: A Meta-Analysis. *Experimental Economics,* 6, pp.299–310.

List of figures

List of tables

Appendix A

In this section, the elaboration of certain tests used in the Results section are presented.

Tests of Normality

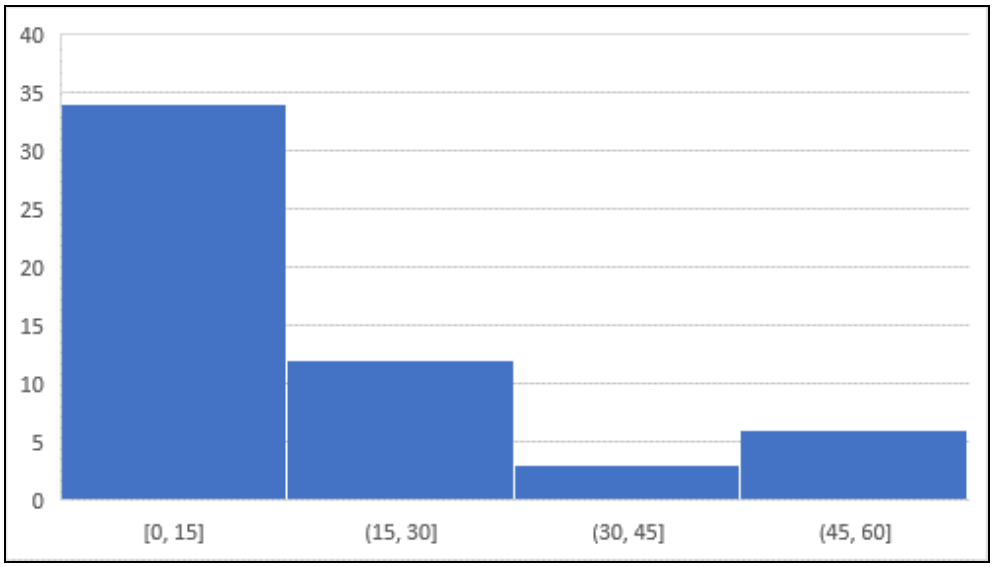
Normality assumption is necessary for carrying out some estimators of statistical inference. In this section tests of normality for various samples are presented.

Sample of men - Amounts that subjects are willing to give up for punish n = 55

- Graphical analysis

Figure 14 shows the frequency distribution of the sample of men and the amounts that they are willing to give up for punish and it does not look like similar to a normal distribution. Shapiro Wilk Test (from now on SW test) is the one applied to test the normality of the distribution.

Figure 14: Frequency distribution of men and their amount spent for punish.



- SW test

H_0. Sample of men comes from a normally distributed population.

H_1. Sample of men does not come from a normally distributed population.

Table 1: SW test for men distribution.

N	55
$\sum(X-'X)^2$	13535.484
A*in* * dif	-104.354
SW c	0.805
SW t	0.947
P Value	0.00

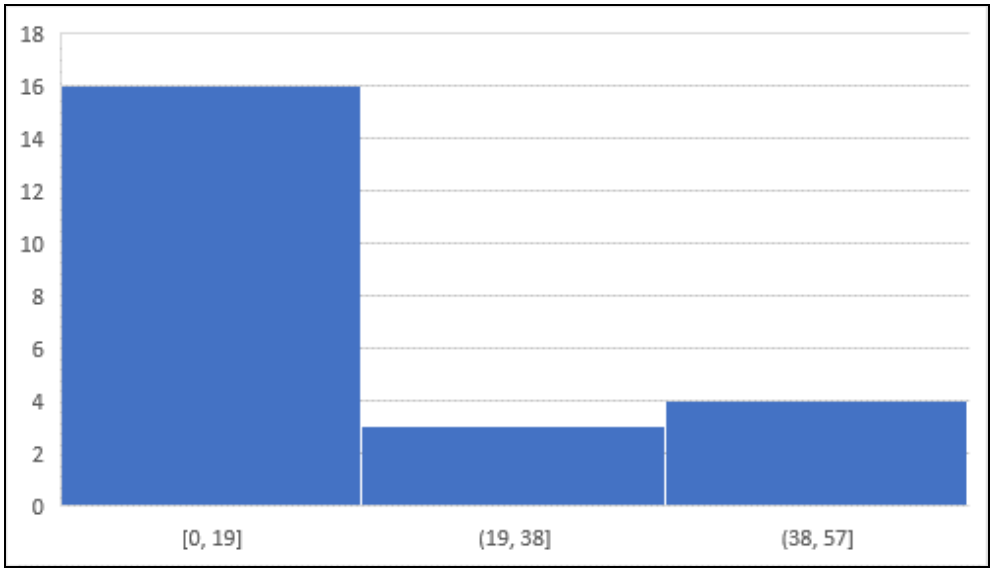
We can reject H_0, sample does not come from a normally distributed population.

Sample of women - Amounts that subjects are willing to give up for punish n = 23

- Graphical analysis

Figure 15 shows the frequency distribution of the sample of men and the amounts that they are willing to give up for punish and it does not look like similar to a normal distribution. SW test is the one applied to test the normality of the distribution.

Figure 15: Frequency distribution of women and their amount spent for punish.



- SW test

H_0. Sample of women comes from a normally distributed population.

H_1. Sample of women does not come from a normally distributed population.

Table 2: SW test for women distribution.

N	23
$\sum(X-'X)^2$	5453.768
A*in* * dif	-66.63
SW c	0.814
SW t	0.914
P Value	< 0.01

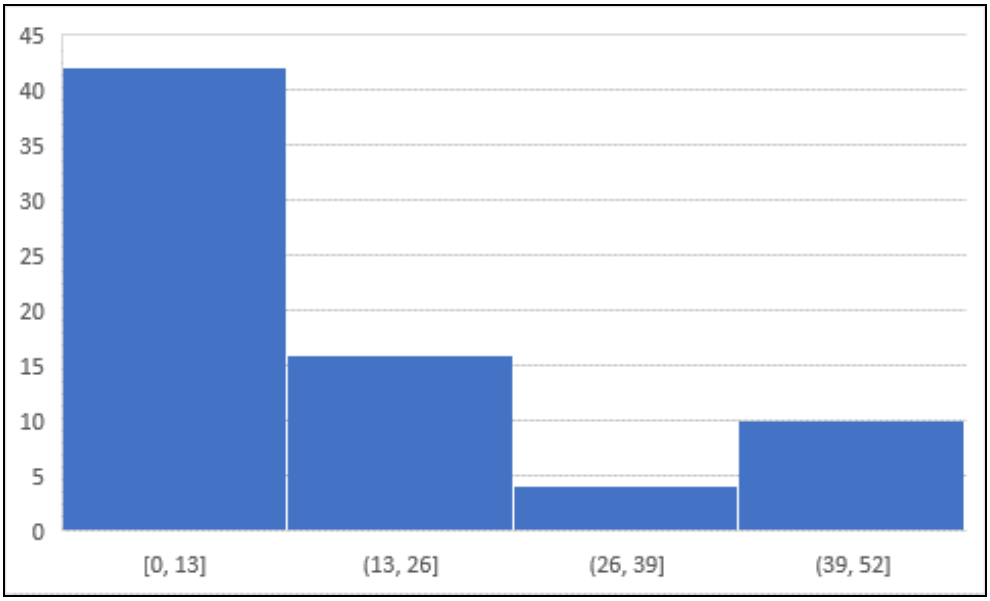
We can reject H_0, sample does not come from a normally distributed population.

Sample of lower level of studies - Amounts that subjects are willing to give up for punish n = 72

- Graphical analysis

Figure 16 shows the frequency distribution of the sample of men and the amounts that they are willing to give up for punish and it does not look like similar to a normal distribution. SW test is the one applied to test the normality of the distribution.

Figure 16: Frequency distribution of subjects with lower level of studies and their amount spent for punish.



- SW test

H_0. Sample of lower level of studies comes from a normally distributed population.

H_1. Sample of lower level of studies does not come from a normally distributed population.

Table 3: SW test for subjects with lower level of studies distribution.

N	72
$\sum$(X-'X)^2	16970.645
A*in* * dif	-114.674
SW c	0.775
SW t	0.947
P Value	0.000

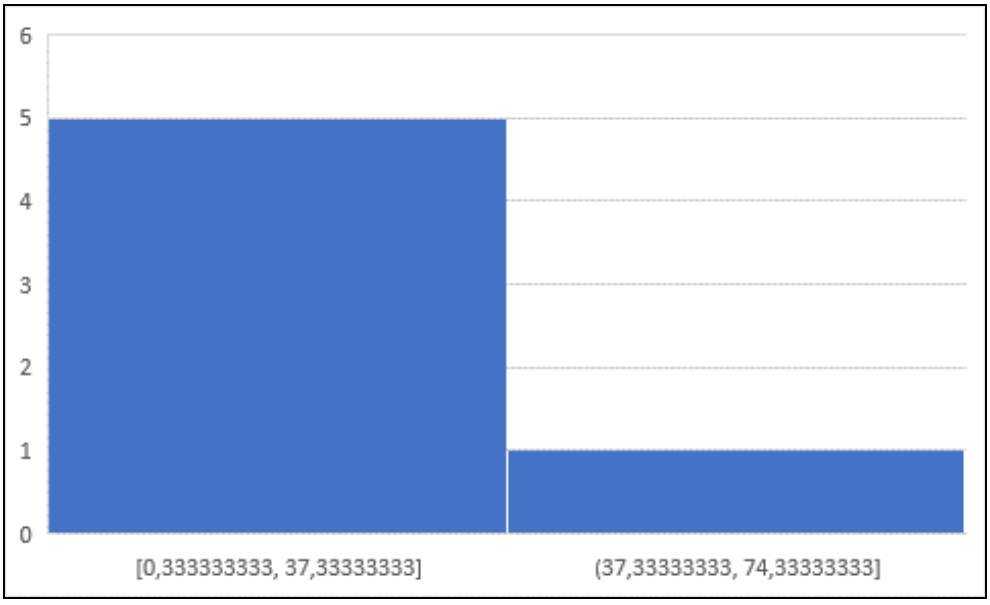
We can reject H_0, sample does not come from a normally distributed population.

Sample of higher level of studies - Amounts that subjects are willing to give up for punish n = 6

- Graphical analysis

Figure 17 shows the frequency distribution of the sample of men and the amounts that they are willing to give up for punish and it does not look like similar to a normal distribution. SW test is the one applied to test the normality of the distribution.

Figure 17: Frequency distribution of subjects with higher level of studies and their amount spent for punish.



- SW test

H_0. Sample of higher level of studies comes from a normally distributed population.

H_1. Sample of higher level of studies does not come from a normally distributed population.

Table 4: SW test for subjects with higher level of studies distribution.

N	6
$\sum(X-'X)^2$	1881.88
A*in* * dif	-32.59
SW c	0.564
SW t	0.788
P Value	0.000

We can reject H_0, sample does not come from a normally distributed population.

Mann Whitney U test

In this section are presented the Mann-Whitney U tests used for comparing differences between male and female and differences between subjects with higher level of studies and subjects with lower level of studies.

Differences in willingness to give up part of the endowment for punishing between men and women.

H_0. $Me_1 = Me_2$ There is no difference between men and women in the willingness to spend part of their endowment for punishing.

H_1. $Me_1 = Me_2$ Willingness to spend part of the endowment for punishing is different between men and women.

Table 5: Mann Whitney U Test for the gender analysis.

Sample	**N**	**Sum of ranges**		**Z**	-0.411
Men	55	**R_1**	2135	**P value**	0.682
Women	23	**R_2**	946		
Total	78				
		U1	670		
		U2	595		
		U [Min (U1, U2)]	595		

With a significant level of 0.05, we can not reject the H_0. Thus, there is no difference between men and women in the willingness to spend part of their endowment for punishing.

Differences in willingness to give up part of the endowment for punishing between subjects with higher level of studies and subjects with lower level of studies.

H_0. $Me_1 = Me_2$ There is no difference between subjects with higher level of studies and subjects with lower level of studies in the willingness to spend part of their endowment for punishing.

H_1. $Me_1 = Me_2$ Willingness to spend part of the endowment for punishing is different between subjects with higher level of studies and subjects with lower level of studies.

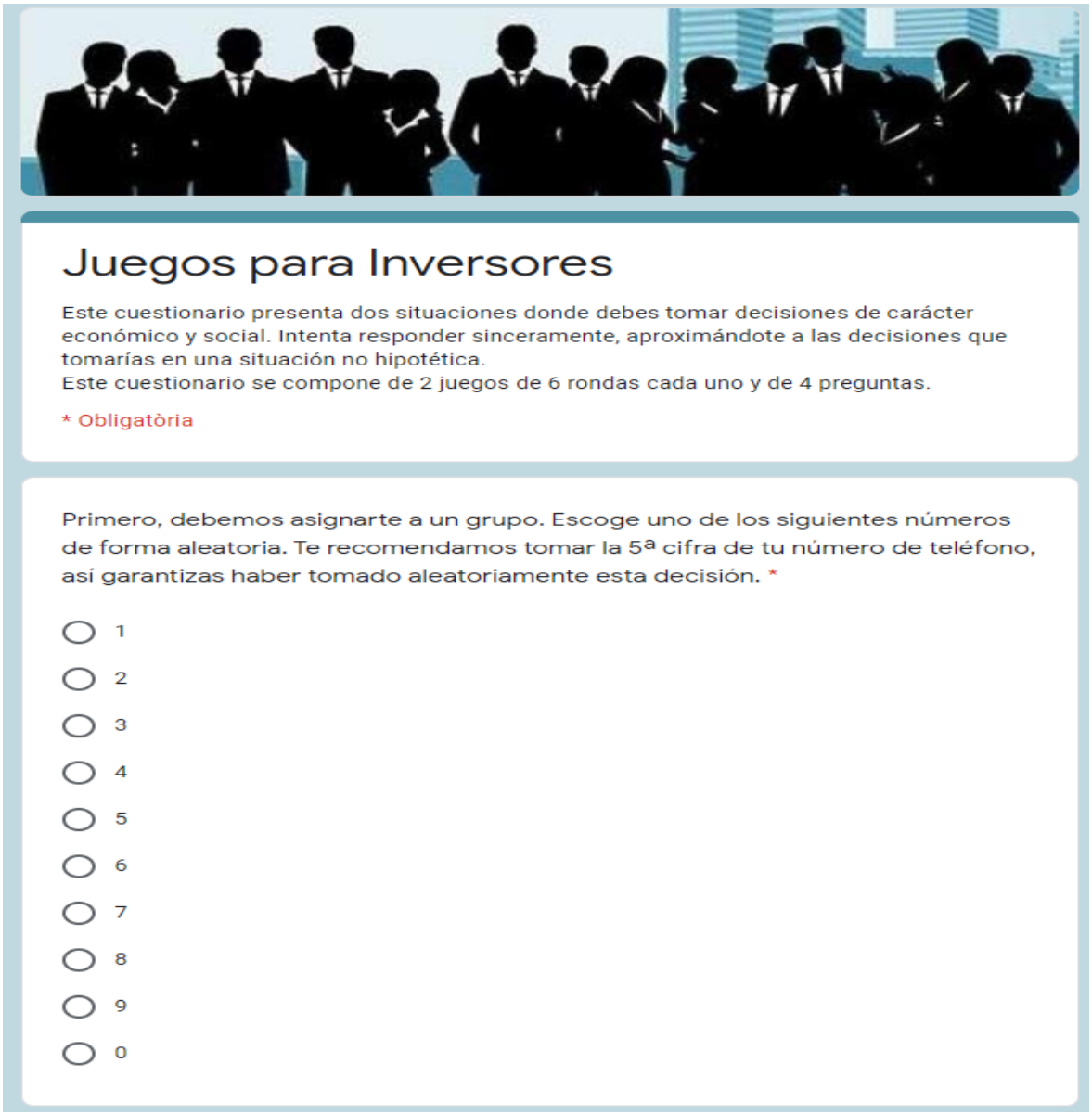
Table 6: Mann Whitney U Test for the level of studies analysis.

Sample	**N**	**Sum of ranges**		**Z**	-2.044
Subjects with lower level of studies	72	**R_1**	2917.5	**P value**	0.041
Subjects with higher level of studies	6	**R_2**	163.5		
Total	78				
		U1	107		
		U2	287		
		U [Min (U1, U2)]	107		

With a significant level of 0.05, we can reject the H_0. Therefore, there is difference between subjects with higher level of studies and subjects with lower level of studies in the willingness to spend part of their endowment for punishing.

Appendix B

In this section the main screenshots of the survey are presented. Each game consists of 6 rounds, but in this appendix are presented only 2 rounds of each game. Questionnaire is available on the following link: https://forms.gle/7SXnzitDcc2Ap1159. Values from each round depends on the decision of the first question, as it was commented in the section Survey Design. The screenshots presented here are showed when the subject choose 1 for the first question. The survey is in Spanish.



Juegos para Inversores

* Obligatòria

Juego 1 Ronda 1 Grupo J

Esta instrucción se repite en las Rondas 1, 3 y 5.

Eres un inversor, estás buscando proyectos rentables para invertir tu capital. Formas parte de un grupo de 4 inversores (contándote a ti mismo). Cada miembro del grupo tiene un capital disponible de 50 Tokens. Se os presentan 2 oportunidades de negocio.

-Inversión en el Proyecto A: por cada Token que inviertas, tú ganas 10 Tokens, mientras que los otros 3 miembros del grupo no ganan nada.
-Inversión en el Proyecto B: por cada Token que inviertas los 4 miembros del grupo (incluido tú) ganáis 5 Tokens cada uno. De la misma manera, las inversiones del resto de miembros de tu grupo en este proyecto también te afectan a ti, y por cada Token que inviertan, tú ganas 5 Tokens.

Por lo tanto, tu beneficio final será 10*(Cantidad Invertida en el Proyecto A) + 5*(La cantidad invertida en el Proyecto B + el total de las cantidades invertidas en el Proyecto B por tus 3 compañeros)

¿Cuánto quieres invertir en el Proyecto B? Tu inversión en el Proyecto A será 50 menos tu inversión en el Proyecto B (si eliges un número decimal, introduce . para la parte decimal) *

La vostra resposta

Enrere Següent

Juegos para Inversores

* Obligatòria

Juego 1 Ronda 2 Grupo J

La cantidad invertida en el Proyecto B por tus 3 compañeros es de 143 Tokens

Te damos la posibilidad de cambiar tu inversión. Conociendo la contribución de tus compañeros, ¿cuánto quieres invertir en el Proyecto B? *

La vostra resposta

Enrere Següent

Juegos para Inversores

Juego 2

Ahora vas a participar en la segunda situación. Este juego es muy similar al anterior, pero no te dejaremos cambiar tu contribución en las rondas pares. Sin embargo, en estas rondas te daremos la posibilidad de sancionar a aquellos inversores que creas que no han tenido un comportamiento correcto, con el fin de que en las próximas rondas aumente la contribución en el Proyecto B.

Los castigos funcionan de la siguiente forma: tú sacrificas una cantidad de tokens de tú beneficio, y a quien le impongas el castigo, verá reducido su beneficio en 2 veces los tokens que hayas sacrificado. En caso de no querer sancionar, escribe 0 para que no reciban castigo.

Enrere Següent

Juegos para Inversores

* Obligatòria

Juego 2 Ronda 1

Esta instrucción se repite en las Rondas 1, 3 y 5.

Eres un inversor, estás buscando proyectos rentables para invertir tu capital. Formas parte de un grupo de 4 inversores (contándote a ti mismo). Cada miembro del grupo tiene un capital disponible de 50 Tokens. Se os presentan 2 oportunidades de negocio.

-Inversión en el Proyecto A: por cada Token que inviertas, tú ganas 10 Tokens, mientras que los otros 3 miembros del grupo no ganan nada.
-Inversión en el Proyecto B: por cada Token que inviertas los 4 miembros del grupo (incluido tú) ganáis 5 Tokens cada uno. De la misma manera, las inversiones del resto de miembros de tu grupo en este proyecto también te afectan a ti, y por cada Token que inviertan, tú ganas 5 Tokens.

Por lo tanto, tu beneficio final será 10*(Cantidad Invertida en el Proyecto A) + 5*(La cantidad invertida en el Proyecto B + el total de las cantidades invertidas en el Proyecto B por tus 3 compañeros)

¿Cuánto quieres invertir en el Proyecto B? Tu inversión en el Proyecto A será 50 menos tu inversión en el Proyecto B (si eliges un número decimal, introduce . para la parte decimal) *

La vostra resposta

Juegos para Inversores

* Obligatòria

Juego 2 Ronda 2

En esta ronda, los miembros de tu grupo han realizado las siguientes contribuciones:

Inversor A: 7 Tokens
Inversor B: 17 Tokens
Inversor C: 39 Tokens

A continuación, con el fin de aumentar las contribuciones en las próximas rondas, tienes la oportunidad de penalizar a los demás miembros de tu grupo que consideres que no han tenido una conducta adecuada.

Para castigarlos puedes gastar una cantidad de tokens y el castigado verá su beneficio reducido en el doble de tokens que tú gastes

Si crees que la conducta de otros inversores es aceptable y no les quieres castigar, puedes gastar 0 tokens y no recibirán castigo.

¿Cuánto quieres gastar para castigar al Inversor A? *

La vostra resposta

¿Cuánto quieres gastar para castigar al Inversor B? *

La vostra resposta

¿Cuánto quieres gastar para castigar al Inversor C? *

La vostra resposta

Juegos para Inversores

* Obligatòria

Cuestionario

Evalúa del 1 al 7 la veracidad de esta afirmación

En estas situaciones, se debería cooperar con los demás para conseguir todo el mundo más dinero. *

	1	2	3	4	5	6	7	
Nada de acuerdo	○	○	○	○	○	○	○	Totalmente de acuerdo

Juegos para Inversores

* Obligatòria

Cuestiones demográficas

Todos los datos se conservarán en el anonimato y solo serán utilizados con fines académicos.

Sexo *

- ○ Mujer
- ○ Hombre

Edad *

La vostra resposta

Nivel de Estudios Completado *

- ○ Primaria
- ○ Secundaria
- ○ Bachillerato o similares
- ○ Universitarios
- ○ Postgrado