Department of Economics and Finance Chair of Microeconomics

SOCIAL PREFERENCES AND SUBJECTIVE BELIEFS IN STRATEGIC SETTINGS: DOES GENDER PLAY A ROLE?

SUPERVISOR Prof. Giovanni Ponti

CANDIDATE Sofia Viviano

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Table of Contents

1. Introduction

Game theory is the study of decision-making in strategic interactions among independent or competing actors. It is a branch of Microeconomics concerned with the analysis of strategies that result in one or more outcomes. Such interactions are modeled into various games in which actors are referred to as players. The point of the game in which all players involved have chosen a strategy to implement and an outcome is reached is called equilibrium. In particular, the Nash equilibrium is a set of strategies, one for each player, that results in the optimal outcome, a situation in which no player has incentive to unilaterally deviate from his or her strategy, given the other players' choice. A game can have more than one Nash equilibrium, or none at all.

Mainstream microeconomic analysis assumes that players within a game are rational in the sense that they only aim at maximizing their own material payoffs. Indeed, Edgeworth (1881) stated that "the first principle of Economics is that every agent is actuated only by self-interest"[1]. However, he also said that the "nineteenth century man is for the most part an impure egoist" meaning that he can feel sympathy for others and care for their happiness at least to a certain extent. Also, Adam Smith (1759) said:

"*However selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it.*"[2]

Indeed, absolute self-interest might be an unrealistic assumption that is not usually supported by behavioral evidence. A more behavioral approach, that results from the integration of psychology into economic theory, overcomes such mainstream assumption. Indeed, Rabin (2002) supports the idea that individuals also care about other people. In particular, he argues that others' material payoff can positively affect our own utility function, possibly because concerns about fairness, equity and social efficiency can influence strategic decision making.

In game theory, this is evident in certain models more than others. For example, this can be found in standard dictator games in which player 1 acts as the Dictator and has to choose the allocation of an initial amount of money between himself and player 2, who acts as the Receiver and must accept the offer.

[1] Edgeworth, F. (1881). *Mathematical Psychics: An Essay on the Application of Mathematics to the Moral Sciences*. London, p.16.

[2] A. Smith (1969) The Theory of Moral Sentiments, Indianapolis, IN: Liberty Classics, p. 47

Since the offer cannot be declined by the Receiver, traditional game theory predicts that the Dictator is 100 percent selfish and will adopt a material payoff maximizing strategy for which he or she will keep the whole amount of money, giving nothing to the receiver. However, experimental research shows that there are cases in which the "donations" are not null, indicating that people care about others. For example, Eckel and Grossman (1996) ran a double-anonymous dictator experiments to study the effect of altruism on subjects' behavior and found that Dictators' donations significantly increase when the Recipient were generally considered to be more "deserving". In particular, donations were higher when the Recipient was an established charity than if it was an anonymous student. Therefore, it can be argued that when fairness is considered by decision-makers, their behavior is rational even if it deviates from material payoff-maximization. Traditional game theory does not allow for such deviations from self-interested behavior and it also assumes that players' own actions are the sole factor influencing their utilities. Psychological game theory, on the other hand, provides adequate tools to take into account "other-regarding" behavior and allow "*psychological*" utilities to also depend directly on expectations (beliefs) which influence social preferences, as Attanasi and Nagel suggest (2008). Furthermore, while Psychological Game Theory suggests that beliefs determine social preferences, an experimental study of Giaccherini and Ponti (2018) has proved that this correlation also works backward and that social preferences have a crucial role in determining beliefs and, thus, choices.

The main purpose of my thesis to test the effect of the observable variable of experimental subjects' gender on social preferences and subjective beliefs. I will use data from the two-phase experiment performed by Giaccherini and Ponti (2018) in which social preferences, measured by the distributional parameters α and β, are estimated in the first phase, and subjective beliefs, conditioned by social preferences, are estimated in the second phase. In their model, α measures aversion to inequality when a player is worse-off relative to another player, and β measures aversion to inequality when a player is relatively better-off. I found that gender has a positive effect on both distributional parameters, but this effect is statistically not significant for both α and β, and it remains so even when another observable variable, subjects' age, is added to the model. However, I also provided evidence that age has a positive and statistically significant effect on β, meaning that as subjects become older, they also become more averse to advantageous inequality. As for the second phase, I found that the effect that gender has on beliefs is again not statistically significant.

I will first explain why self-interest is not the only motive affecting behavior and how the concepts of sympathy and commitment, discussed by Sen (1977), can influence decision-making analysis. I will then provide a general discussion about the role of fairness as a motive for human behavior, distinguishing the concept of *intention-based reciprocity* proposed by Rabin (1993) from the *self-centered inequality aversion* model of Fehr and Schmidt (1999).

While in the former case, we are dealing with beliefs-dependent preferences, in the latter case we are dealing with distribution-dependent preferences. Then, I will explore alternative behavioral motives such as efficiency concerns and maximin preferences analyzed by Engelmann and Strobel (2004).

I will continue my analysis on social preferences by exploring the tradeoff between fairness and robustness (efficiency) and introducing the concept of strategic uncertainty discussed by Cabrales et al. (2010). I will then present the problem of identification of decision rules through social preferences and subjective beliefs discussed by Manski (2002) and Bellemare et al. (2008). To conclude this section, I will discuss how psychological game theory is needed to analyze beliefs-dependent preferences by analyzing a simple two-stage trust game presented by Attanasi and Nagel (2008). In section 3, I present original results from the experimental study by Giaccherini and Ponti (2018) about social preferences' influence on subjective beliefs and, in section 4, I perform structural estimations on their experiment to explore the role that gender possibly has in this matter. Section 5 concludes.

2. Literature Contributions

Economic interactions are social interactions; thus, social preferences derived from fairness motives should be taken into account when analyzing behavior in strategic settings. Economists often assume that people are 100 percent self-interested (Rabin, 2002); however, experimental evidence suggests that this assumption is unrealistic and that some people are not completely selfish, and other factors can influence their choices. From this, it can be argued that sympathy, commitment, social preferences such as inequality aversion, and other-regarding behavior in general such as altruism, might influence behavior in strategic interactions. It can also be argued that material payoffs are not the only motivation of decision making since they are not the sole factor affecting utility. Therefore, social preferences and beliefs can also influence utility functions and behavior. If this is the case, traditional game theory may not always provide the right framework of analysis of such situations.

2.1 Self-interest, Sympathy and Commitment

The Indian economist and philosopher Sen (1977), in "*Rational Fools. A Critique of the Behavioral Foundations of Economic Theory*", argued that, in many economic models, man is unrealistically reduced to be a self-seeking egoist because of a standardized concept of rationality. Choices are considered to be rational only if they are consistent with revealed preferences. In simple terms, if a person is observed to choose apples instead of bananas, he or she is considered to prefer apples over bananas. If this same person then deviates from this strategy and chooses bananas instead of apples in another occasion, then either his preferences are considered to be changing or the person is deemed as inconsistent and thus irrational. Following this line of reasoning, a rational human's real preferences can be understood only through his or her choice which are made to satisfy his or her own interest. Contrarily, Sen (1977) argues that choices can be influenced by a compromise of various considerations that can go well beyond a person's own welfare. In particular, he includes two concepts in the analysis of human behavior: sympathy and commitment. Sympathy is regarded as a person's concern for other people which affects his or her own utility. Commitment is that feeling of responsibility towards choosing a certain action because a person feels it is the right thing to do, even if this action lowers his or her personal welfare and the person could have chosen a different available alternative yielding a higher sense of well-being. Sen (1977) makes clear that sympathy can be considered as egoistic because a person might be pursuing others' happiness because it increases his or her own welfare. On the other hand, commitment is deemed as non-egoistic because even if the action chosen maximizes a person's welfare, that was not the reason for his or her choice.

Commitment is a result of morality concerns, rules of conduct, modes of behavior, cultural factors, a sense of responsibility due to mutual trust and many other reasons that overcome a person's own preferences. A person might prefer to go to the beach instead of studying, but he chooses to study for an exam instead, because he or she believes it is the right thing to do. Therefore, when admitting commitment as part of behavior, it is evident that choice might not actually reflect preferences and that self-interest is not the sole motive of behavior.

Sen (1977) also provides s prominent example of this discussion: the Prisoners' Dilemma. This dilemma presents a situation in which two robbers are interrogated for a robbery with no witnesses. They have two strategies, to cooperate with each other and remain silent or not cooperate and testify for the prosecution against each other, but they must choose their own strategy separately and without communicating. Therefore, no player knows what the other player has actually chosen until after the decision is made, he or she can only have beliefs about it. If only one subject acts as selfish and testifies against the other, he does not go to jail but the other, who remained silent, gest three years of jail. If they both cooperate and remain silent, they only get one year of jail each for loitering. If they both choose to not cooperate and to testify against each other, they get two years of jail each, for a total of four years. By remaining silent, the worst-case scenario for each player is that he or she has to face three years if the other person testifies. Meanwhile, by testifying, the worst-case scenario for each player is that he or she has to face two years if the other testifies as well. Since each player cannot be sure that the other will cooperate and remain silent, and because two years of jail are better than three, traditional game theory predicts that they will both choose the selfish option to not cooperate and testify against each other, although they would have been better-off by choosing the non-selfish option to cooperate and remain silent.

As Sen (1977) argues, the selfish strategy "is the only rationally defensible strategy", pursuant to Traditional Game Theory. However, empirical evidence shows that people playing the Prisoners' Dilemma often choose the unselfish option to cooperate and remain silent. For example, a person might feel sympathetic towards the other player and he would choose the non-egoistic option to cooperate so that the other player's happiness and in turn his or her own happiness increase. Also, if one takes the concept of commitment into account, a person might believe that it is not "fair" to testify if the other player remains silent because the difference in years of jail would be too big. So, he would choose the non-egoistic option to cooperate. The concept of fairness is indeed a very important one.

2.2 Fairness Theory

Rabin (1993), in "*Incorporating Fairness into Game Theory and Economics*", models fairness as altruism and he claims that it is contingent to others' behavior. Behind his concept of fairness, there is a principle of *intention-based reciprocity* by which people consider the intention behind others' actions and respond to it accordingly. He argues that people tend to be altruistic to those who treat them fairly (*positive reciprocity*) and to punish those who hurt them (*negative reciprocity*), even at their own expense. For example, a manager will be likely to reward an employee who has always been loyal and productive, and the same manager might fire an employee who has not done his or her job properly. Also, a consumer will not buy a product if he or she perceives it to have an "unfair" price, thus sacrificing the utility that he or she would have gained from that particular good or service. Rabin (1993) argues that the role of expectations is crucial to analyze the effect of fairness on economic theory. Therefore, when developing a framework to analyze *intention-based reciprocity*, utilities should be belief-dependent because perceived and actual fairness depend on expectations. Indeed, in his two-players model, the expected utility of player *i* depends on his own strategy ($a_i \in S_i$ for player *i* and $a_j \in S_j$ for player *j*), his belief on what player *j* will choose as a strategy ($b_i \in S_i$ for player *i* and $b_j \in S_j$ for player *j*) and also on player *j*'s belief about player *i*'s belief regarding the player *j*'s strategy ($c_i \in S_i$ for player *i* and $c_j \in S_j$ for player *j*).

In his model, he first defines how much player *i* is actually being "fair" to player *j* by dividing the difference between the actual payoff of player *j* and the equitable payoff with the difference between his highest possible payoff and his minimum possible payoff. In this case, all the payoff functions depend on player *j*'s belief on player *i*'s action and the actual payoff depends also on player *i*'s action. The equitable payoff is a reference point calculated by dividing by two the difference between the player *j*'s highest possible payoff and the lowest payoff he can get among the Pareto-efficient payoffs.

Rabin (1993) defines this "kindness function" as:

$$f(a_i, b_j) \equiv \frac{\pi_j(b_j, a_i) - \pi_j^{\mathrm{e}}(b_j)}{\pi_j^{\mathrm{h}}(b_j) - \pi_j^{\min}(b_j)} .$$

Secondly, he defines player *i*'s belief on how much kind player *j* is being fair to him as:

$$\tilde{f}_j(b_j, c_i) \equiv \frac{\pi_i(c_i, b_j) - \pi_i^{\mathrm{e}}(c_j)}{\pi_i^{\mathrm{h}}(c_i) - \pi_i^{\min}(c_i)} .$$

Rabin (1993) explains that if $\tilde{f}_j$ (.) < 0, it means that player *i* believes that player *j* is treating him "unfairly", and so he will choose a strategy a_i to punish player *j*, resulting in f_j (.) to be low or even negative. On the other hand, if $\tilde{f}_j$ (.) > 0, it means that player *i* believes that player *j* is treating him "fairly", and so he will choose a strategy a_i to treat player *j* kindly, resulting in f_j (.) to be relatively high.

Using these "kindness functions", Rabin (1993) then defines the expected utility as:

$$U_i(a_i, b_j, c_i) \equiv \pi_i(a_i, b_j) + \tilde{f}_j(b_j, c_i) \cdot [1 + \tilde{f}_i(a_i, b_j)] .$$

If player *j* is treating player *i* "unfairly", player *i*'s utility will be lower than his payoff, and vice versa. Therefore, U_i (.) $\leq \pi_i$ (.) when $\tilde{f}_j$ (.) < 0 and U_i (.) $\geq \pi_i$ (.) when $\tilde{f}_j$ (.) > 0.

Finally, Rabin (1993) defines the *fairness equilibrium* as the pair of strategies $(a_i, a_j) \in (S_i, S_j)$ that occur if:

$$(1) \quad a_i \in \arg\max_{a \in Si} U_i(a, b_j, c_i) ;$$
$$(2) \quad c_i = b_i = a_i .$$

Furthermore, from his analysis, Rabin (1993) concluded that, for small material payoffs, an outcome is a *fairness equilibrium* if it is a *mutual-max* outcome, in which each individual maximizes the other's material payoff, ceteris paribus, or a *mutual-min* outcome, in which each individual either minimizes the other's material payoff, ceteris paribus. However, this "kindness function" only depends on factors contingent to others' behavior. On the other hand, the analysis of fairness presented by Fehr and Schmidt (1999) can be better used to isolate fairness motives from the concept of *reciprocity*.

2.3 Fairness Modeled as Inequality Aversion

Fehr and Schmidt (1999), in "*A theory of fairness, competition and cooperation*", model fairness as *self-centered inequality aversion*, meaning that differences in payoffs across different individuals result in disutility; yet, people seek equitable outcomes only to the extent that their payoff is "fair" relative to that of others. In their model of inequality aversion, in order to analyze how relative material payoffs affect a person's utility function and his or her behavior, fairness perceptions are based on a reference point; this being the *egalitarian outcome*. This outcome is a situation in which payoffs are the same for every player.

The main assumption of the model presented by Fehr and Schmidt (1999) is that utility is negatively affected by inequitable outcomes if a person is relatively worse-off, because he or she envies other players, but also if a person is relatively better-off, because he or she feels guilty about having more than others. They also assume that such negative impact on utility is bigger in the case of envy. Payoff distribution here plays a key role. While Rabin (1993) deals with beliefs-dependent preferences, Fehr and Schmidt (1999) deal with distribution-dependent preferences.

Fehr and Schmidt (1999) present the following formula to define player *i*'s utility function of for *n* players:

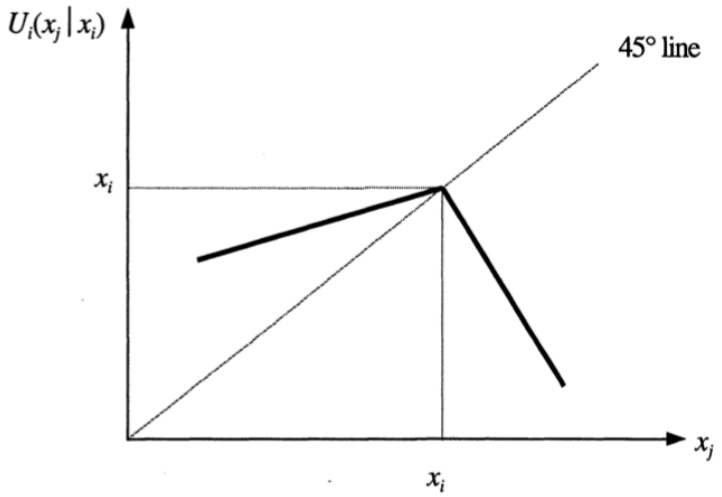
$$U_i\,(x) = \; x_i \; - a_i \frac{1}{n\; - 1} \sum_{j \neq i} \max\{x_j - \; x_i, 0\} \; - \; ß_i \; \frac{1}{n - 1} \; \sum_{j \neq i} \max\{x_i - \; x_j, 0\}, \;\; i \neq j \, .$$

When only 2 players are considered, the formula simplifies to:

$$U_i\,(x) = \; x_i \; - a_i \max\{x_j - \; x_i, 0\} \; - \; ß_i \; \max\{x_i - \; x_j, 0\}, \;\; i \neq j \, .$$

In both cases, Fehr and Schmidt (1999) define $x = x_1, \ldots, x_n$ as the vector of monetary payoffs. Also, the term with the α coefficient represents the negative impact that *disadvantageous inequality* has on utility, so when player *i* is worse-off with respect to player *j* ($x_i < x_j$). On the other hand, the term with the β coefficient with $0 \leq \beta < 1$ measures the loss of utility from *advantageous inequality*, so when player *i* is better-off relative to player *j* ($x_i > x_j$). However, this hostility for perceived "unfairness" is not absolute in this model because Fehr and Schmidt (1999) assume that $\alpha_i \geq \beta_i$. This implies that a person's utility is hurt relatively more by a form of inequality that places him or her in a disadvantageous position with respect to others ($x_i < x_j$). As Fehr and Schmidt (1999) argue, "a subject is loss averse in social comparisons: negative deviations from the reference outcome count more than positive deviations". Indeed, as shown in Figure 1, the utility function when $x_i < x_j$ is steeper than when $x_i > x_j$ and it reaches its maximum when the difference in the payoffs is null ($x_i = x_j$).

Figure 1



(Source: Fehr and Schmidt, 1999)

In Fehr and Schmidt's model, the utility of player *i* as a function of the other player's payoff, given player *i*'s own payoff, is assumed to be linear in inequality aversion for simplicity, implying that the marginal rate of substitution between payoff and inequality is constant. However, Fehr and Schmidt (1999) suggest that there are also games in which nonlinear inequality aversion is exhibited by a significant portion of subjects. They provide the example of dictator games, in which payoffs are given by $x_i = 1 - s$ and $x_j = s$, where s is the share that player *i*, the Dictator, offers to player *j*, the Recipient. In Fehr and Schmidt's model, a linear utility function results in too extreme predictions: the Dictator will offer $s = 0.5$ when $\beta > 0.5$, which is an extremely "fair" outcome, and $s = 0$ when $\beta < 0.5$, which is an extremely "unfair" outcome. However, Fehr and Schmidt (1999) also stated that another research by Forsythe, Horowitz, Savin and Sefton (1994) showed that about 60 percent of the subjects chose to offer more than 0 but less than half of the pie ($0 < s < 0.5$), only about 20 percent of them chose to keep everything for themselves, and only another 20 percent decided to offer $s = 0.5$, which is exactly half of the initial amount of money. Therefore, Fehr and Schmidt (1999) concluded that, for dictator games, the utility function should be concave in order to allow optimal offers to lie within the interval [0, 0.5].

2.4 Alternative Behavioral Motives: Efficiency and Maximin Preferences

Other than inequality aversion, there are also alternative behavioral motives such as efficiency concerns and maximin preferences that are important to consider.

The former is defined as the concern for achieving the largest sum of all the payoffs, the latter as the desire to maximize the lowest payoff. Engelmann and Strobel (2004), in "*Inequality Aversion, Efficiency, and Maximum Preferences in Simple Distribution Experiments*", compared the two measures of inequality aversion by Fehr and Schmidt (1994, from this time forth F&S) and Bolton and Ockenfels (2000, from this time forth ERC) in three different games, to analyze the relative importance of efficiency concerns, maximin preferences and inequality aversion. Engelmann and Strobel (2004) explain that, according to ERC, people prefer to have their own payoff as close as possible to the average payoff and do not care whether others' payoff are relatively "fair" or not. On the other hand, F&S predicts that subjects prefer a payoff which is the same for everyone. Engelmann and Strobel (2004) performed experiments for taxation games, envy games and rich and poor games, in which subjects were asked to choose the allocation of material payoffs between three persons. Only the choice of person 2 would actually define material payoff allocation and subjects would be randomly assigned any of the three roles after having made a decision.

In the taxation game, these three persons were characterized respectively as "low income", "middle income" and "high income". The available options were defined as different tax systems with different degrees of redistribution. The allocations, predictions by ERC and F&S, maximin and efficient allocations, and decisions for various treatments of this game are provided in Table 1.

Table 1

	Treatment											
	F			E			Fx			Ex		
Allocation	A	B	C	A	B	C	A	B	C	A	B	C
Person 1	8.2	8.8	9.4	9.4	8.4	7.4	17	18	19	21	17	13
Person 2	5.6	5.6	5.6	6.4	6.4	6.4	10	10	10	12	12	12
Person 3	4.6	3.6	2.6	2.6	3.2	3.8	9	5	1	3	4	5
Total	18.4	18	17.6	18.4	18	17.6	36	33	30	36	33	30
Average 1, 3	6.4	6.2	6	6	5.8	5.6	13	11.5	10	12	10.5	9
Relative 2	0.304	0.311	0.318	0.348	0.356	0.364	0.278	0.303	0.333	0.333	0.364	0.4
Prediction												
Efficiency	A			A			A			A		
ERC			C	A					C	A		
F&S	A					C	A					C
Maximin	A					C	A					C
Choices												
Count	57	7	4	27	16	25	26	2	2	12	5	13
Percentage	83.8	10.3	5.9	39.7	23.5	36.7	86.7	6.7	6.7	40	16.7	43.3
Subtreatments												
F1 and E1	29	3	2	14	8	12						
F2 and E2	28	4	2	13	8	13						

(Source: Engelmann and Strobel, 2004)

In treatment F, efficiency coincides with the F&S prediction and maximin preferences. In treatment E, efficiency coincides with the ERC prediction. Engelmann and Strobel (2004) concluded that the fact that the distribution of decisions was different for the two treatments means that efficiency matters. Indeed, the results show that F&S outperformed ERC among the subjects who stated that fairness concerns influenced their decision, and that a significant number of subjects said that efficiency affected their choices.

The envy game is so called because envy is a likely motive that could lead the middle-income subject to take money from the poor one only to decrease the rich one's payoff. Here, choices are modeled such that the F&S prediction is Pareto-dominated by the ERC one. An outcome is said to be Pareto-dominated by another outcome if this other outcome would make at least one player better-off without hurting any other player. Engelmann and Strobel (2004) modeled treatment N in a way such that the payoff of person 2 is constant for every choice, in the treatments Nx, Ny and Nyi, such payoff is different in each allocation so that it is possible to see whether subjects would sacrifice their own payoff either to reduce inequality or to increase efficiency. The authors also explained that, since the outcome of these treatments are in line with the constant-own-payoff treatment N, the result of treatments Nx, Ny and Nyi is not biased by the fact that the decision maker's payoff does not vary across choices. The allocations, predictions by ERC and F&S, maximin and efficient allocations, and decisions for various treatments of this game are provided in Table 2.

Table 2

	Treatment											
	N			Nx			Ny			Nyi		
Allocation	A	B	C	A	B	C	A	B	C	A	B	C
Person 1	16	13	10	16	13	10	16	13	10	16	13	10
Person 2	8	8	8	9	8	7	7	8	9	7.5	8	8.5
Person 3	5	3	1	5	3	1	5	3	1	5	3	1
Total	29	24	19	30	24	18	28	24	20	28.5	24	19.5
Average 1, 3	10.5	8	5.5	10.5	8	5.5	10.5	8	5.5	10.5	8	5.5
Relative 2	0.276	0.333	0.421	0.3	0.333	0.389	0.25	0.333	0.45	0.263	0.333	0.436
Prediction												
Efficiency	A			A			A			A		
ERC		B		A or B				B or C			B or C	
F&S			C	A	or	C			C			C
Maximin	A			A			A			A		
Choices												
Count	21	8	1	25	4	1	23	4	3	18	5	7
Percentage	70	26.7	3.3	83.3	13.3	3.3	76.7	13.3	10	60	16.7	23.3

(Source: Engelmann and Strobel, 2004)

Results shows that, for envy games, ERC outperforms F&S. Indeed, in treatment N, 26.7 percent of the subjects chooses option B, which is in line with the ERC prediction, while only 3.3 percent of the subjects chose option C, which is the one in line with the F&S prediction. Similar outcomes occurred in all of the other treatments. Engelmann and Strobel (2004) argue that this is because F&S is Pareto-dominated by the ERC. However, the authors also stated that if the disutility would be assumed to be quadratic in inequality, as it should be for dictator games, the F&S prediction would perform better than the ERC one. Therefore, Engelmann and Strobel (2004) concluded that in this kind of games, efficiency concerns and maximin preferences are important factors motivating behavior only if combined with Pareto-dominance and if there is space for other motives such as inequality aversion.

In the rich and poor games' treatments, the decision maker's payoff remains constant across the three different options he or she can choose, and it is either the highest or the lowest payoff. Therefore, F&S predicts the same outcome as ERC. Also, Engelmann and Strobel (2004) explicate that since the minimal payoff is constant, maximin preferences cannot influence the experiment's outcome and it is possible to isolate the contrast between efficiency and inequality aversion. The allocations, predictions by ERC and F&S, maximin and efficient allocations, and decisions for various treatments of this game are provided in Table 3.

Table 3

	Treatment								
	R			P			Ey		
Allocation	A	B	C	A	B	C	A	B	C
Person 1	11	8	5	14	11	8	21	17	13
Person 2	12	12	12	4	4	4	9	9	9
Person 3	2	3	4	5	6	7	3	4	5
Total	25	23	21	23	21	19	33	30	27
Average 1, 3	6.5	5.5	4.5	9.5	8.5	7.5	12	10.5	9
Relative 2	0.48	0.522	0.571	0.174	0.19	0.211	0.273	0.3	0.333
Prediction									
Efficiency	A			A			A		
ERC	A					C			C
F&S	A					C			C
Maximin			C	A or B or C					C
Choices									
Count	8	6	16	18	2	10	12	7	11
Percentage	26.7	20	53.3	60	6.7	33.3	40	23.3	36.7

(Source: Engelmann and Strobel, 2004)

Engelmann and Strobel (2004) presented the following results. In treatment R, in which F&S and ERC predict the most efficient choice A, 53.3 percent of the subject pool picked choice C in which payoffs are relatively balanced. On the other hand, in treatment P, in which F&S and ERC predict the relatively equal payoff choice C, 60 percent of the subjects picked choice A, the most efficient one. Thus, the majority of subjects preferred the efficient allocation when it is not minimizing inequality, and such choices are in line with maximin preferences.

Overall, the authors conclude that since neither the α nor the β component of the F&S model have a significant impact, the will to increase the lowest payoff is solely due to maximin preferences and not to inequality aversion. Also, the ERC prediction has a negative marginally significant impact. Therefore, when analyzing the extent to which fairness modeled as inequality aversion influences behavior, alternative motives such as efficiency concerns and maximin preferences should be considered. In particular, Engelmann and Strobel (2004) stated that "a combination of efficiency concerns, maximin preferences and selfishness can rationalize most of the data" to explain behavior in the best possible way.

2.5 Social Preferences and Strategic Uncertainty

Inequality-averse social preferences have important consequences also in strategic settings in which the principal has to allocate rewards to agents. Principals face a tradeoff between fairness and robustness (efficiency) when deciding upon agents' rewards. This is because inequalities are necessary to induce a high effort performance. By rewarding an agent more than others, a principal can make that agent perform better and this can in turn incentivize other agents to perform better as well. Therefore, principals have to choose between a robust but less "fair" reward scheme or a more equal yet inefficient rewards allocation resulting in the low effort outcome. Cabrales et al. (2010), in "*Social Preferences and Strategic Uncertainty: An Experiment on Markets and Contracts*", argue that such tradeoff is intensified by the presence of distributional preferences. In particular, they suggest that this is because agents might prefer working for a principal who has social preferences that are similar to theirs. For example, if an agent is relatively inequality averse, then he or she might perform better in a work environment promoting equality.

Cabrales et al. (2010) performed a three-phase experiment to determine the extent to which social preferences are crucial determinants of choices, in particular in the labor market. In the first phase (P_1), "Dictator Game", pairs of subjects are involved in a (Random) Dictator Game and have to choose among four material payoff pairs. Afterwards, an independent draw randomly sets who among the two agents is the Dictator so that his or her choice defines material payoffs for that round. Empirical evidence from this phase is used to estimate distributional preference parameters. In the second phase (P_2), "Effort Game", pairs of subjects have to choose between material payoff options modeled as contracts yielding a 2 x 2 effort game which will be later played. Teammates' contract choices may influence the second-stage effort decisions. Empirical evidence from this phase is used to estimate reciprocity parameters and beliefs in the effort game. In the last phase (P_3), "Market", four principals compete with each other by offering a contract in the form of the 2 x 2 effort game to pairs of agents who, by choosing their preferred contract, sort themselves among different principals. Empirical evidence from this phase is used to test whether agents tend to decide to work for principals that have distributional preferences that are similar to theirs.

Cabrales et al. (2010) clarify that agents' monetary payoffs in P_2 and P_3 depend on their effort decisions, and that within each pair of agents, player 1 receives significantly more than player 2 so that such inequality induces both to make effort. $\delta_i \in \{0, 1\}$ represents the agent's effort decision. If he chooses to make an effort, then $\delta_i = 1$, while if he or she does not, then $\delta_i = 0$. If both chose to make an effort, each monetary payoff will be higher than if only one does so; if they both choose $\delta_i = 0$, they both receive only a fixed monetary prize, B. Cabrales et al. (2010) explained this by defining agent *i*'s payoff function as follows.

$$(1) \qquad \pi_{it}^{k}(\partial) = B + P(\partial) b_{it}^{k} - \partial_i c$$

with

$$(2) \qquad P(\partial) = \begin{cases} 0 & \text{if } \partial_1 + \partial_2 = 0 \\ \gamma & \text{if } \partial_1 + \partial_2 = 1 \\ 1 & \text{if } \partial_1 + \partial_2 = 2 \end{cases}$$

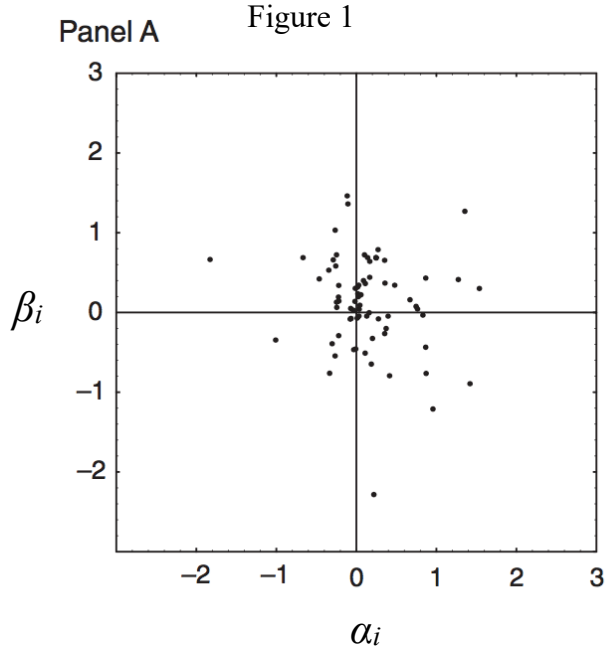
Each principal, instead, receives a payoff derived from each team that accepts the proposed contract and it is computed by subtracting total costs ($b_1^k + b_2^k$) from total output (V), and this amount would then be divided by how many other principals offer that same accepted contract.

$$\pi_0^k(\partial) = P(\partial)(V - b_1^k - b_2^k)$$

Furthermore, Cabrales et al. (2010) present two mechanism design problems to induce effort decisions. One is the "weak effort inducing" solution (*wing* from this time forth), in which each player's decision to make an effort is contingent to the other player's choice. The other is the "strong effort inducing" one (*sting* from this time forth), in which player 1 will make such decision independently of player 2's choice, but player 2 is still subject to a *reciprocity* concern with respect to player 1's action, making this contract more "unfair" than the former. The authors also clarify that while for *sting* there are no multiple equilibria and $\delta_1 = \delta_2 = 1$ is the unique equilibrium, for *wing* there are be multiple equilibria and $\delta_1 = \delta_2 = 0$ can be one of them. Therefore, each player has uncertain beliefs about the other player's effort decision which influence his or her own choice. This is known as *strategic uncertainty*. Indeed, by using two mechanism design strategies, Cabrales et al. (2010) intended to investigate the role of inequality aversion and strategic uncertainty aversion influencing behavior. From the analysis of the subjects' revealed preferences over the type of contracts, Cabrales et al. (2010) concluded that the *sting* contract is more frequently chosen by principals and agents than the *wing* one, and the bigger the payoff difference of *wing*, the bigger the probability that *sting* is chosen. It appears that subjects tend to prefer the more equal option and, therefore, that inequality aversion plays a role in determining their decisions. However, also strategic uncertainty influences behavior. Cabrales et al. (2010) show that when the *wing* contract is chosen, the efficient all-effort equilibrium is played less frequently than the inefficient all-no effort one. Also, the non-equilibrium outcome, in which only one player provides effort, is more frequent for *wing* contracts than for *sting* ones. Indeed, effort is higher in *sting* contracts than in *wing* ones and this difference in the effort they cause compensates the difference in their cost. Moreover, in "*Social Preferences and Strategic Uncertainty: An Experiment on Markets and Contracts*", it is shown that player 1 always provides more effort than player 2 and this is probably due to the fact that he is the advantaged one. Also, while the fact that player 1 is the Dictator does not influence his or her effort choice, when player 2 is the Dictator he or she provides less effort. Furthermore, player 2's misbehavior is conditional on whether he or she is the Dictator or not; on the other hand, player 1 never reacts to misbehavior.

Overall, Cabrales et al. (2010) concluded that reciprocity effects are not statistically significant, and beliefs are influenced only by monetary payoffs. Therefore, social preferences influence the tradeoff between robustness and fairness present in the choice between *wing* and *sting*, but only for the disadvantaged player 2. Indeed, estimated distributional parameters are significant in determining agents and principals' observed decisions. The coefficients α_i and β_i of each subject of the experiment are plotted in Figures 1 and 2 which correspond to two graphs, namely Panel A and Panel B.

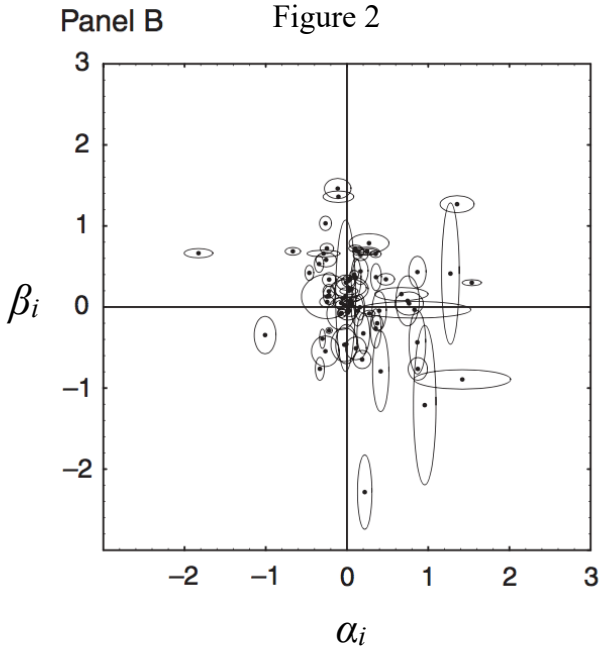
Figure 1



(Source: Cabrales et al., 2010)

In Panel A, each point represents a subject in the (α_i, β_i) space. It can be seen that subjects display significant heterogeneity in their distributional preferences.

Figure 2



(Source: Cabrales et al., 2010)

Panel B represents also the 95 percent confidence intervals associated with each estimated distributional parameter pair. Panel B shows that there are subjects whose estimated distributional preferences lies in more than one quadrant. Also, the null hypothesis of Egoistic Preferences ($\alpha_i = \beta_i = 0$) cannot be rejected at the 10 percent confidence level for about 20 percent of the sample.

2.6 Identification of Decision Rules through Social Preferences and Beliefs

To continue the discussion about social preferences and believes, I would like to present some considerations of Manski (2002) in "*Identification of decision rules in experiments on simple games of proposal and response*". He argues that many experimental studies are based on assumptions that agents' rational expectations are needed to identify preferences because observed choice information is usually not enough to identify both expectations and preferences. He explores the possibility of formally identifying decision rules yielding observed choices from experimental finite-sample data in Proposer-Responder simple games. In these games, Manski (2002) assumes that all subjects want to maximize their own expected utility; however, they can have different preferences and expectations. The author designs the situation framework as follows. Agents with the same preferences, expectations and values of *socially relevant attributes*, belong to the same type. Each subject's utility function depends on his own payoff and on the other players' payoff and type. Player 2, the Responder, knows player 1's action, but he does not know his type, thus he or she places a subjective distribution on it. On the other hand, player 1, the Proposer, knows neither player 2's action nor his type, thus he or she places a joint subjective distribution on both.
Manski (2002) suggests that inferring on their utility functions and subjective distributions means inferring on their decision rules and that this is possible if one can derive decision rules from choice probabilities, given that it exists a unique action maximizing expected utility. However, he also clarify that since different decision rules can lead to the same experimental outcome, the researches would need other information other than experimental data to formally identify agents' decision rules. Therefore, prospects for identification and reliable inferences need the right data. With this respect, Manski (2002) argues that one way is to perform a joint analysis of multiple experiments, and another is the elicitation of expectations and subjective distributions through household surveys.

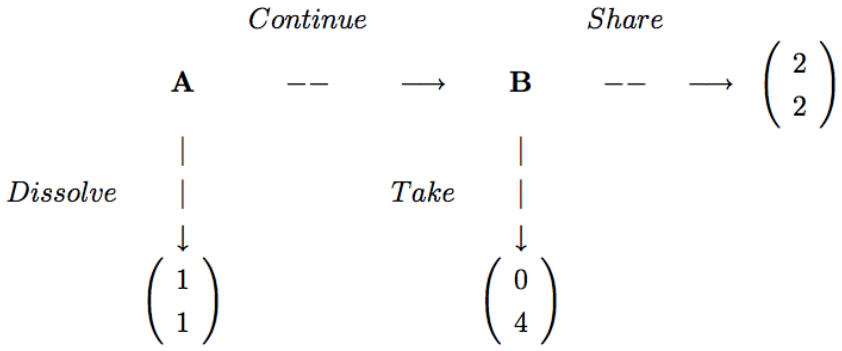
Bellemare et al. (2008) dealt with such elicitation issue by directly asking Proposers about their subjective probability distribution over Responders' actions. In their econometric model, another important feature is that preferences and expectations (beliefs) change with observable background characteristics and observed variables, such as gender. Their model also allows for correlation between proposers' preferences for inequality aversion and beliefs, and, in turn, a spurious correlation between their beliefs and actions. This means that social preferences can influence expectations, and that beliefs and actions only seem to exhibit interdependence between each other, but they actually do not. They performed experiments using ultimatum games and dictator games.

It is interesting to note the main findings of Bellemare et al. (2008)'s research. Firstly, the subjective probabilities given by the Proposers about the expected Responders' acceptance rate do not coincide with the actual Responders' acceptance rates. Secondly, their model outperforms a model assuming that Proposers have rational expectations that fit the observes choice data. In particular, the latter did not predict well the shape of the offer distribution in the dictator game. Furthermore, Bellemare et al. (2008) concluded that the more a subject is optimistic in his or her expectations the less his or her disadvantageous inequality aversion.

2.7 Psychological Game Theory and Beliefs-dependent Preferences

While social preferences are based on individual rankings over outcomes that are certain and so no risk is taken into consideration by decision makers, individual beliefs are formed under uncertainty. For this reason, as Giaccherini and Ponti (2018) suggest, economists have always considered how people form preferences and beliefs as two independent processes. However, Psychological Game Theory (PGT) support the idea that beliefs influence preferences. Geanakoplos et al. (1989), in "*Psychological Games and Sequential Rationality* ", argue that payoffs in psychological games depends on a hierarchy of belief-dependent psychological considerations, because players' expectations influence their emotions and emotional reactions. They develop a framework of formal analysis of situations in which beliefs-dependent preferences influence outcomes and find that subgame perfect and sequential psychological equilibria exist, but that backward induction fails as a method for finding them. Geanakoplos et al. (1989) suggest that this is because a player of an extensive form game might unexpectedly reach some information set and form new opinions, and other players might in turn form new opinions subsequently.

Attanasi and Nagel (2008), in "*A Survey of Psychological Games: Theoretical Findings and Experimental Evidence*" analyze a simple two-stage trust game in which beliefs-dependent motivations play a role.



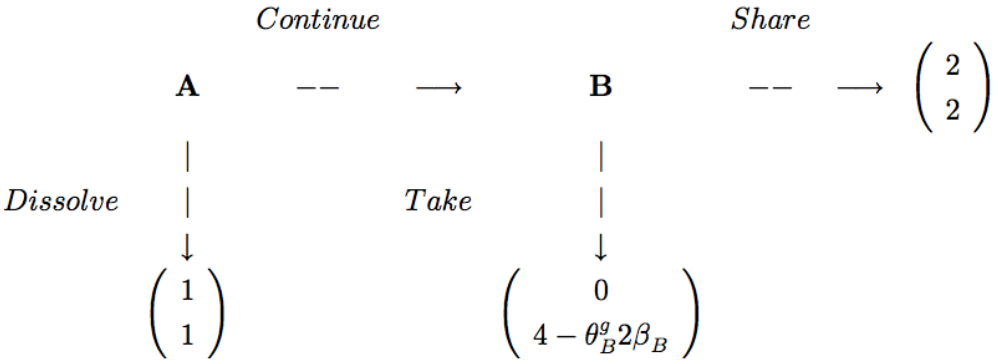
(Source: Attanasi and Nagel, 2008)

In this game, Attanasi and Nagel (2008) define player A and player B respectively as the truster ("he") and the trustee ("she") of a partnership for a project. Player A moves first and he has to decide whether to *dissolve* or *continue* the partnership. In case he decides for the former option, the players equally share a total profit of 2€. In case he decides for the latter option, player B has can either *share* a total profit of 4€ equally between herself and player A or *take* the whole amount, leaving nothing to the truster. Traditional Game Theory assumes that it is common knowledge that both players are self-interested and only aim at maximizing their own material payoff. Indeed, it allows for a unique subgame perfect equilibrium in which since player B would choose to *take* the whole amount of profits for herself if player A would *continue* the partnership, the truster will choose to *dissolve* the partnership to get 1€ instead of 0€. The truster would do so even if (*Continue*, *Take*) would be a more efficient outcome overall, yielding a higher total material payoff.

Attanasi and Nagel (2008) clarify that Traditional Game Theory analysis framework would still work for distributional-dependent preferences *à la* Fehr and Schmidt, but the outcome would be different from the one previously described. If it is common knowledge that the truster is only self-interested and that the trustee happens to be also inequality averse, player B would choose to equally *share* profits, in case player A would *continue* the partnership. This is because the difference in the material payoffs is 0 which is smaller than the difference in the material payoffs for the *take* option which would be 4. Since the truster knows this, he would choose to *continue* the partnership since he would receive 2€ instead of 1€, and thus the unique equilibrium would be (*Continue*, *Share*).

However, Attanasi and Nagel (2008) then consider belief-dependent preferences. In particular they focus on guilt aversion, for which a player's utility is harmed by receiving a higher material payoff relative to another player. They also take into account the theory of sensitivity to guilt aversion of for which a player's utility would be harmed by disappointing another player's expectations. Attanasi and Nagel (2008) therefore assume that player A remains only self-interested and that player B is also guilt averse. Therefore, player B holds *conditional* second-order beliefs (β_B) about player A's *initial* first-order beliefs (α_A). In this case, α_A is A's belief that if he decides to *continue* the partnership, player B will decide to *share* profits, and β_B is player B's belief that she would choose to *share* profits if player A will *continue* the partnership. Therefore, player B's total utility in case she would choose to *take* the whole amount of profits, after player A has chosen to *continue* the partnership, is no longer just the material payoff of 4€. Player B believes that player A trusts her to *share* profits after he chooses to *continue*; thus, the trustee feels that she owes to player A the actualization of trust fulfillment or otherwise she would disappoint the trustee.

As a result, also player B's disutility from disappointing player A, due to player B's guilt aversion, has to be considered. Such disutility is the amount of disappointment (-2 β_B) multiplied by the trustee's guilt aversion sensitivity (θ_B^g). Thus, player B's total utility after (*Continue*, *Take*) now becomes the difference between her material payoff and her psychological utility due to belief-dependent preference for guilt aversion (4-θ_B^g-2 β_B). Thus, the trust game's payoff scheme changes.



(Source: Attanasi and Nagel, 2008)

So, in the case of belief-dependent preferences, the Traditional Game Theory's framework no longer works and that of Psychological Game Theory is needed. However, Attanasi and Nagel (2008) highlight that, in order to achieve an equilibrium, beliefs must be correct and thus, since utility functions take into account beliefs, also stated utilities must be correct ($\alpha_A = \beta_B$). Also, PGT does not take into account that beliefs about other players' beliefs can change as the game is played and that, thus, *updated beliefs* and *updated utilities* should be considered in the analysis of strategic settings in which beliefs-dependent motivations emerge.

3. Empirical Analysis

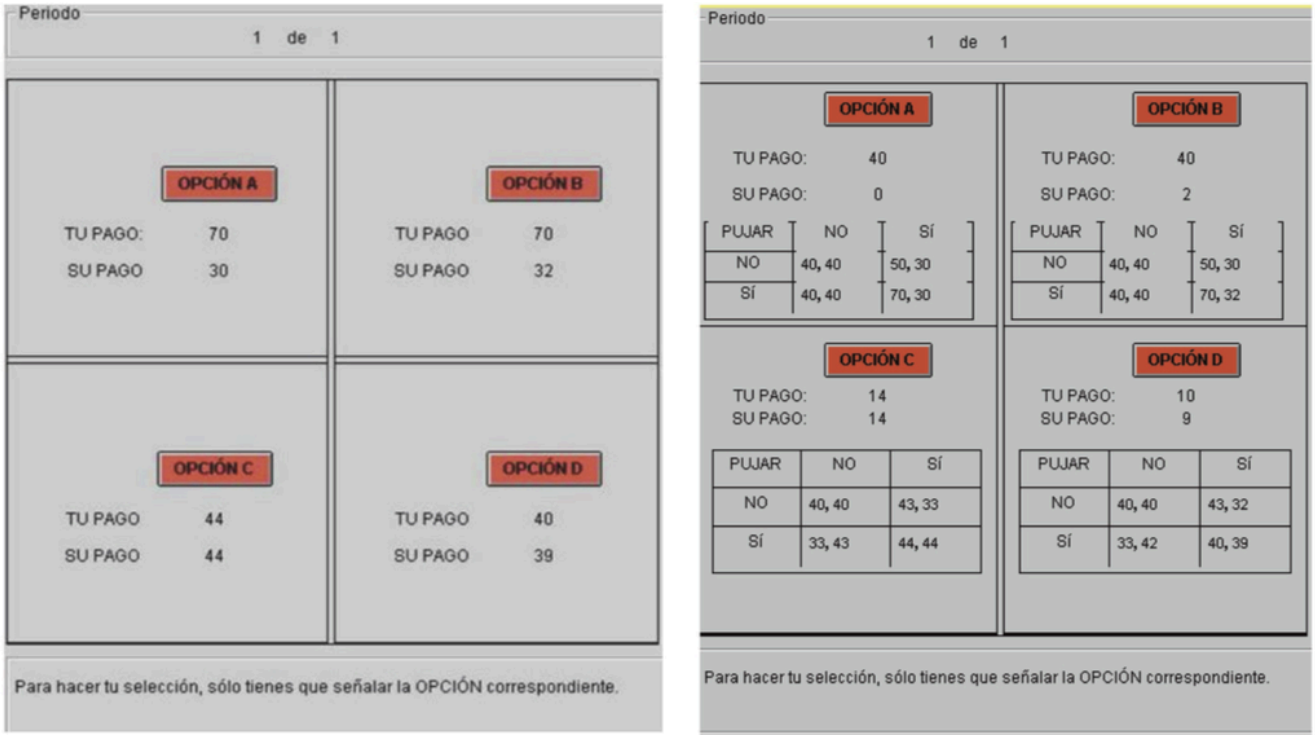
A deeper analysis on the relationship between social preferences and beliefs is provided by by Matilde Giaccherini and Giovanni Ponti (2018) in their experimental study "*Preference Based Subjective Beliefs*". In this section, I will provide original results from their experiment.

3.1 Giaccherini and Ponti (2018): Preference Based Subjective Beliefs

As already stated in section 2.7, Psychological Game Theory (PGT) suggests that beliefs influence preferences. On the other hand, Giaccherini and Ponti (2018) argue that social preferences influence strategic beliefs. The main purpose of Giaccherini and Ponti's experiment is to test whether social preferences observed in a Random Dictator Game significantly determine estimated beliefs in a related 2 x 2 effort game and, if so, in which direction. In the authors' multi-stage experiment, the two phases are the same as those of Cabrales et al. (2010) described in section 2.4. The user interface for the first phase (P_1) and for the second one (P_2) are shown in Figure 3.

Figure 3

(P_1) (P_2)



(Source: Giaccherini and Ponti, 2018)

In P_1, each player is paired with another player and can choose between four options of payoff allocation. Then, the Dictator is randomly chosen between the two players. For example, if one player chooses option A, he chooses the payoff allocation such that he or she keep 70 and the other player in the team only gets 30. This could be considered the most selfish option. Option B allows the player who chooses it to keep again 70 but it gives a bit more to the other player than option A does, 32 instead of 30. Therefore, a subject choosing option B would be considered more altruist or simply more concerned about overall efficiency than one picking option A. Option C is less efficient than the first two options since the sum of payoffs is 88 which is less than 100 for option A and 102 for option B. However, option C results in the so-called *egalitarian outcome* since the payoffs are the same for both players. Finally, option D is the most inefficient and would appear to be the most irrational choice. However, subjects might choose this option if they care about fairness and equality, but only to the extent that their own material payoff is larger than the other player's material payoff. It is important to recall the model of fairness introduced by Fehr and Schmidt (1999):

$$U_i\,(x) = x_i - a_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_j - x_i, 0\} - ß_i \frac{1}{n-1} \sum_{j \neq i} \max\{x_i - x_j, 0\}, \quad i \neq j\,.$$

It assumes that the utility loss from disadvantageous inequality is larger than that lost from advantageous inequality, that is $\alpha_i \geq \beta_i$. In this first phase, the distributional parameters α and β, and thus social preferences, are estimated.

In the second phase of the experiment performed by Giaccherini and Ponti (2018), teammates select contract options yielding a 2 x 2 effort game related to the contract choice of the randomly drawn Dictator. In the 2 x 2 effort game, each player's action profile is defined by $\delta \in (0, 1)$. When player *i* plays the "NO" strategy, he or she chooses not to exert effort and $\delta_i = 0$; if he or she chooses the "SI" strategy, he or she decides to make effort and $\delta_i = 1$. Option C is the most equal option and the only one for which the all effort equilibrium, $\delta_1 = \delta_2 = 1$, is the unique equilibrium and also the most efficient one. In this phase, Giaccherini and Ponti (2018) make the expected payoff of each player depend on his or her effort decision $\delta \in (0, 1)$ which is conditional on his or her subjective beliefs on how likely the other player is to exert effort, λ. That is:

$$u_i(0\,|_\lambda) = \lambda[(2-i)(\gamma - \beta(\gamma(1-\theta)+\kappa)) + (i-1)(\gamma\theta - \beta(\gamma(\theta-1)+\kappa)];$$

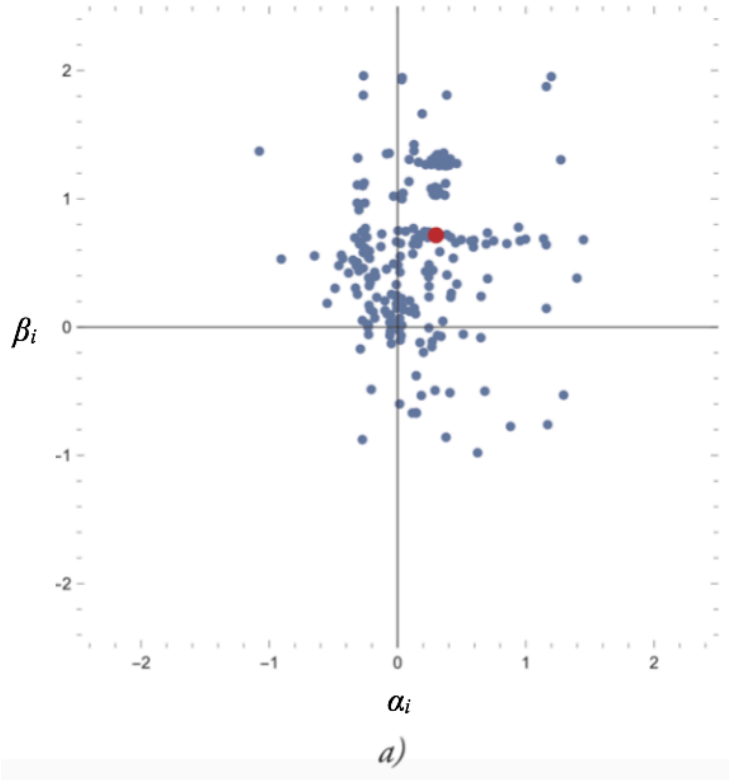
$$u_i(1\,|_\lambda) = (1-\lambda)[(2-i)(\gamma - \kappa - \alpha(\gamma(\theta-1)+\kappa)) + (i-1)(\gamma\theta - \kappa - \alpha(\gamma(1-\theta)+\kappa)] + \\ +\lambda[(2-i)(1-\kappa-\beta(1-\theta)) + (i-1)(\theta - \kappa - \alpha(1-\theta)].$$

It is important to say that λ depends on the distributional parameters α and β. This is how Giaccherini and Ponti (2018) establish the proposed causal link from preferences to beliefs.

If players have social preferences, payoff difference and effort decisions are important. Giaccherini and Ponti (2018) suggest that *envy* is generated when the other player in your team does not exert effort, but you do. On the other hand, *guilt* arises from free-riding on your teammate's effort. The authors clarify that when a player believes that the likelihood of the event in which his or her teammate exert effort increases, λ increases. If this occurs, the difference in payoffs decreases and so *guilt* increases while *envy* decreases. As a result, welfare is enhanced. Indeed, Giaccherini and Ponti (2018) argue that a change in the expected payoff will result in a change in the expected utility, which will in turn influence the probability μ_i that player i will exert effort. Therefore, this two-stage experiment allows to distinguish the *direct* effect of the distributional parameters on utility estimated in P_1 from their *indirect* effect on beliefs estimated in P_2.

The distributional parameters α_i and β_i of each subject estimated in P_1 are plotted in Figures 4 and 5, namely graphs *a* and *b*.

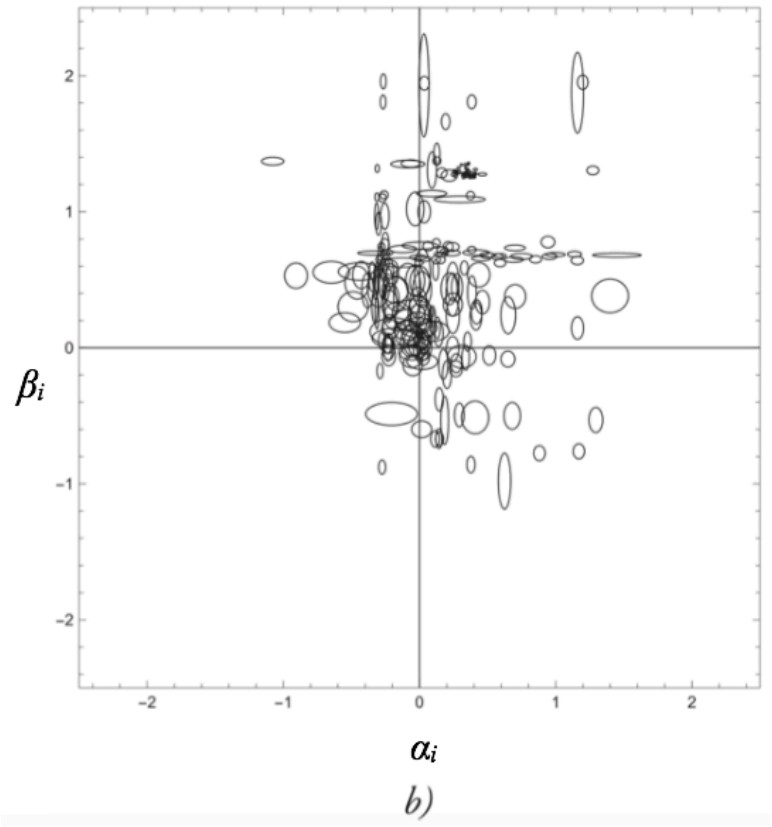
Figure 4



(Source: Giaccherini and Ponti, 2018)

In graph *a*, each point represents a subject in the (α_i, β_i) space. It can be seen that subjects display a certain extent of heterogeneity in their distributional preferences.

Figure 5



(Source: Giaccherini and Ponti, 2018)

Graph *b* represents also the 95 percent confidence intervals associated with each estimated distributional parameter pair. Graph *b* shows that there are subjects whose estimated distributional preferences lies in more than one quadrant. Also, Giaccherini and Ponti (2018) concluded that about half of the subjects tend to be relatively more selfish since the null hypothesis of Egoistic Preferences, $\alpha = \beta = 0$, could not be rejected at the 5 percent confidence level. Meanwhile, the other half of the subject pool presents *inequity averse* preferences discussed in section 1.2, $\alpha > 0$ and $\beta > 0$ (Fehr and Schmidt 1999), status *seeking preferences*, $\alpha > 0$ and $\beta < 0$ (Rey-Biel, 2008), and *efficiency seeking* preferences discussed in section 1.3, $\alpha < 0$ and $\beta > 0$ (Engellman and Strobel, 2004).

As for the second phase of the experiment, Table 4 reports the estimated coefficient of four different logit specification for λ, the subjective beliefs on how likely the other player is to exert effort. Giaccherini and Ponti (2018) clarify that player *i*'s effort decision in P_2 ($\delta_i \in \{0, 1\}$) is the dependent variable and it is conditional on the material payoffs chosen by the Dictator.

In Models (1) and (2) the same experimental design as that of Cabrales et al. (2010) is used and, thus, beliefs depend on game-form characteristics only. These are, (i) the wage level when both players exert effort, "Myb" and "Herb", (ii) the assignment of players' role, in which if player 2 is the decision-maker then the dummy variable "Pl. 2" is positive, and (iii) the contract type that can be either *wing* or *sting*. Giaccherini and Ponti (2018)'s results show that player *i* expects more effort from player *j* as player *j*'s material payoff increases and as player *i*'s payoff decreases. These findings confirm those of Cabrales et al. (2010). Furthermore, Giaccherini and Ponti (2018) contribute to the literature by including the distributional parameters estimated in P_1 in the set of regressors. This is done in Models (3) and (4). Beliefs are estimated *indirectly*, as a component of the difference in the expected material payoffs. Table 4 shows that the distributional parameters always have a significant impact, α has a positive one while β has a negative one. This effect is nonlinear for the distributional parameter α, since the coefficient of α^2 is negative and significant.

Table 4

Lambda	**(1)**	**(2)**	**(3)**	**(4)**
Myb	–0.071 ***	–0.001	–0.102 ***	–0.091 ***
	(0.005)	(0.027)	(0.005)	(0.0118)
Herb	0.022 ***	–0.014	0.034 ***	0.031 ***
	(0.004)	(0.015)	(0.003)	(0.007)
Pl. 2		0.108		–0.041
		(0.070)		(0.041)
STING		–2.602 ***		–0.603
		(0.950)		(0.463)
Pl. 2 × STING		2.762 ***		0.550
		(1.050)		(0.483)
α			2.444 ***	2.429 ***
			(0.287)	(0.276)
α^2			–0.898 ***	–0.899 ***
			(0.245)	(0.240)
β			–0.610 ***	–0.645 ***
			(0.212)	(0.218)
β^2			–0.126	–0.108
			(0.110)	(0.111)
cons.	0.482 ***	–0.029	1.016 ***	0.972 ***
	(0.072)	(0.220)	(0.145)	(0.157)
LogLik	–8197.051	–8098.377	–6534.9277	–6504.0093

Std. err. in parentheses—*** $p < 0.01$.

(Source: Giaccherini and Ponti, 2018)

Overall, Giaccherini and Ponti (2018) concluded that the distributional coefficients α and β estimated in P_1 are significant determinants of first-order beliefs estimated in P_2. In particular, while subjects who exhibit higher *guilt* expect others to put less effort, those who exhibit higher *envy* expect others to put more effort. Therefore, social preferences influence subjective beliefs.

4. Structural Estimations: Does Gender Affect Social Preferences and Beliefs?

I would like to focus on the impact that gender possibly have on social preferences and subjective beliefs. I will do so by analyzing the effect that the observable variable gender has on distributional parameters α and β estimated in P_1 of the experiment of Giaccherini and Ponti (2018), and whether this creates in turn a significant effect of gender on subjective beliefs on how likely the other player is to exert effort, λ, estimated in P_2. I will carry out my analysis through a panel dataset provided by the professor Giovanni Ponti.

In the first phase, distributional parameters are estimated. The mean of each distributional parameter estimated in P_1 can be seen in the table below and it is 0.114 for the α coefficient and 0.223 for the β one. Therefore, it can be argued that, on average, subjects of this sample tend to be more averse to advantageous inequality than to disadvantageous inequality. This can be seen in Table 5.

Table 5

Variable	Obs	Mean	Std. Dev.	Min	Max
alpha_id	12,912	.1137285	1.562766	-22.15641	9.523046
beta_id	12,912	.2234126	3.040381	-21.15641	2.299028

From the histograms below, which I generated through Stata, it can be seen that both distributional parameters appear to follow a normal distribution, with the majority of observations close to the average.

Figure 6

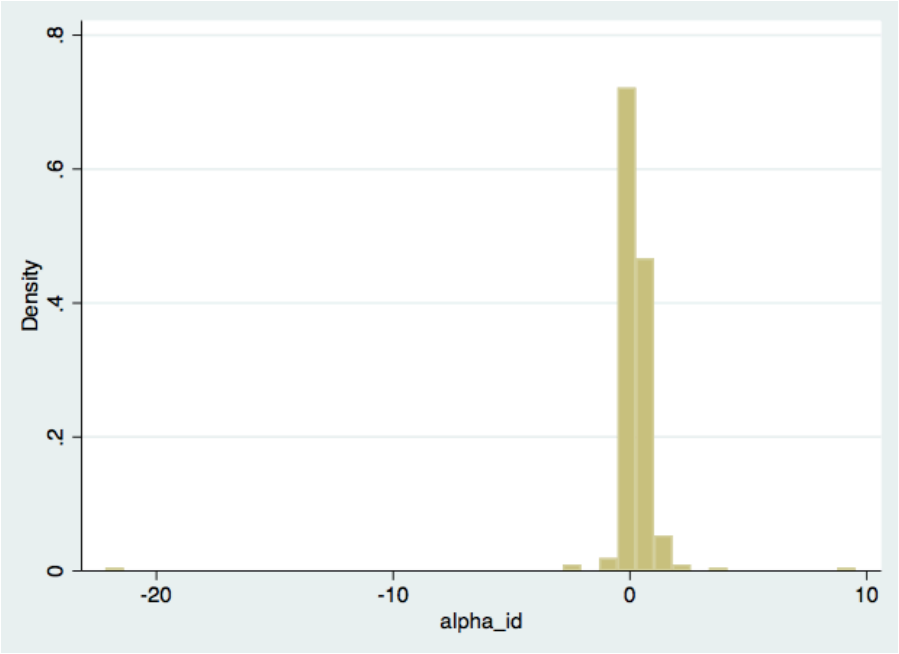
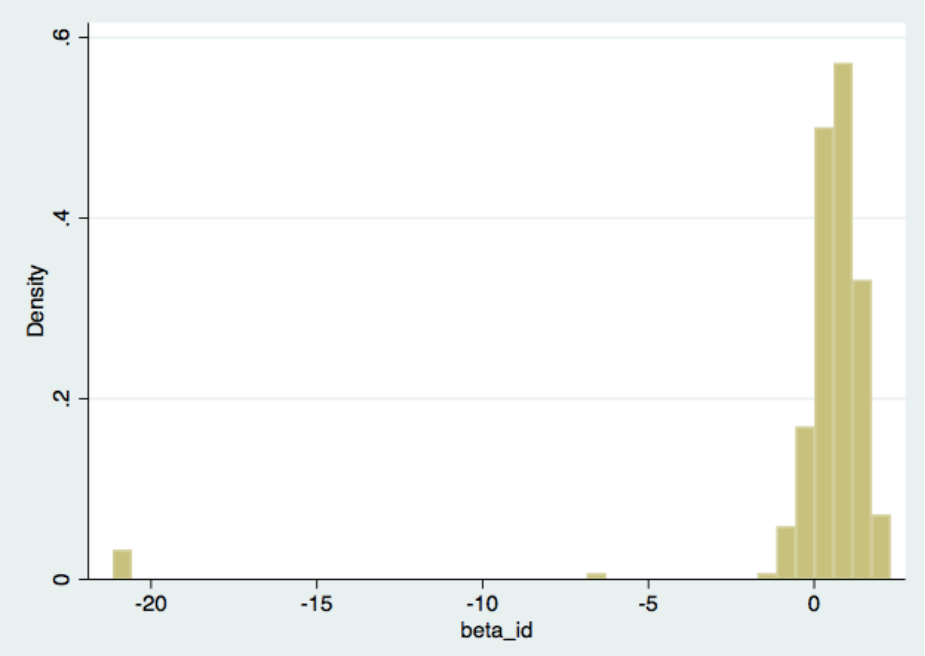


Figure 7



After subjects participated to the experiment by Giaccherini and Ponti (2018), they had to complete a questionnaire from which observable variables are obtained. The dummy variable "female" takes the value of 0 for men and 1 for women. From the table below, it can be seen that 51.39 percent of the subjects are men and that 48.61 percent of subjects are women. This means that the subject pool is well-balanced with this respect.

Table 6

Female	Freq.	Percent	Cum.
0	7,104	51.39	51.39
1	6,720	48.61	100.00
Total	13,824	100.00	

In the first model presented in Table 7, the constants measure males' distributional parameters α and β, whereas the "female" variable shows the difference between the distributional coefficients of women and that of men. From Table 7, it can be seen that women are slightly more inequality averse than men. Indeed, female subjects are found to be 0.01 percent more inequality averse than male ones when they are worse-off relative to the other player they are paired with. They are also 0.11 percent more inequality averse than men when they are relatively better-off. However, we can see that, in both cases, the p-value is greater than 0.05 and thus this effect is statistically not significant.

Table 7

myplan	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
alpha_id						
female	.0097042	.014542	0.67	0.505	-.0187976	.038206
_cons	.2955156	.0115148	25.66	0.000	.272947	.3180841
beta_id						
female	.1110936	.1974103	0.56	0.574	-.2758234	.4980106
_cons	.6871646	.0148747	46.20	0.000	.6580107	.7163186

In the second model, I add the variable "age" to see whether the significance of the effect of gender on inequality aversion changes by adding another observable variable. As it is shown in Table 8, the age range is between 18 and 50, but the majority of subjects are between 19 and 24 years old. Any subject might have provided a false age on the questionnaire; however, it is not possible for me to control for this bias.

Table 8

Age	Freq.	Percent	Cum.
18	768	5.61	5.61
19	1,152	8.42	14.04
20	1,344	9.82	23.86
21	2,256	16.49	40.35
22	2,448	17.89	58.25
23	1,392	10.18	68.42
24	1,584	11.58	80.00
25	912	6.67	86.67
26	576	4.21	90.88
27	288	2.11	92.98
28	192	1.40	94.39
29	144	1.05	95.44
30	96	0.70	96.14
31	96	0.70	96.84
32	48	0.35	97.19
33	96	0.70	97.89
35	48	0.35	98.25
36	48	0.35	98.60
37	48	0.35	98.95
38	48	0.35	99.30
42	48	0.35	99.65
50	48	0.35	100.00
Total	13,680	100.00	

In the following table, results from Stata are summarized.

Table 9

myplan	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
alpha_id						
female	.0089958	.0144592	0.62	0.534	-.0193438	.0373353
age	.0011393	.0013102	0.87	0.385	-.0014286	.0037072
_cons	.2704266	.0329646	8.20	0.000	.2058172	.3350359
beta_id						
female	.1418092	.1266297	1.12	0.263	-.1063804	.3899988
age	.0228624	.0046148	4.95	0.000	.0138176	.0319073
_cons	.1691608	.1054209	1.60	0.109	-.0374603	.375782

It can be seen that the distributional parameters α and β slightly increase with subjects' age. Indeed, a 1-year increase in age results in a 0.001 percent increase in disadvantageous inequality aversion, but this effect is statistically not significant because the p-value is greater than 0.05. Also, a 1-year increase in age results in a 0.023 percent increase in advantageous inequality aversion, and this effect is highly significant because the p-value is 0. This means that as people become older, they also become more averse to inequity, when they are relatively better-off. In this model, the positive effect that gender has on the distribution parameter α and β remains statistically insignificant as in the first model I presented.

In the second phase, subjective beliefs on how likely the other player is to exert effort, λ, are estimated for each player. The effect of gender on beliefs is not statistically significant since the p-value is greater than 0.05. This effect remains statistically insignificant even when the observable variable "age" is added to the model.

The results can be summarized in the following table.

Table 10

Vars	(1)	(2)	(3)	(4)
Myb	-0.0709***	-0.00403	-0.103***	-0.0928***
	(0.00495)	(0.0260)	(0.00486)	(0.0103)
Herb	0.0222***	-0.0126	0.0347***	0.0317***
	(0.00387)	(0.0148)	(0.00293)	(0.00612)
female	-0.0439	-0.0511	-0.0670	-0.0821
	(0.0905)	(0.0954)	(0.0578)	(0.0599)
age	-6.00e-05	0.000764	-0.000808	-0.000628
	(0.0107)	(0.0112)	(0.00744)	(0.00740)
alpha_id			2.473***	2.467***
			(0.307)	(0.289)
alpha_id_2			-0.901***	-0.906***
			(0.274)	(0.264)
beta_id			-0.615***	-0.648***
			(0.193)	(0.209)
beta_id_2			-0.116	-0.0978
			(0.106)	(0.111)
Ipring		0.101		-0.0468
		(0.0671)		(0.0404)
PPT		-2.483***		-0.562
		(0.930)		(0.464)
Ipring_PPT		2.646**		0.511
		(1.028)		(0.484)
Const.	0.510*	0.00698	1.054***	1.021***
	(0.266)	(0.354)	(0.245)	(0.242)
Obs.	6,168	6,168	6,168	6,168

Standard errors in parentheses - *** p<0.01, ** p<0.05, * p<0.1

5. Conclusions

The integration of psychological realism into mainstream economics resulted in the birth of Behavioral Economics, questioning those assumptions which behavioral economists consider unrealistic. The main assumption most economic models rely on is that rational individuals are self-seeking persons who only aim at maximizing their own material payoff. However, many experimental studies provide empirical evidence that behavior is motivated also by other factors. The ones I present in my thesis are: sympathy, commitment, fairness concerns, altruism, intention-based reciprocity, self-centered inequality aversion, efficiency concerns, maximin preferences and guilt aversion. All these factors are regarded as social preferences and they have an important relationship with how individuals form their beliefs and then make choices. Taking into account also these behavioral motives means that Traditional Game Theory might not always provide the adequate tools to analyze certain situations and outcomes.

My thesis analyzes social preferences and their relationship with beliefs in strategic settings. I present a number of experimental studies on this matter, but I mainly focus on that of Giaccherini and Ponti (2018): "*Preference Based Subjective Beliefs*". While Psychological Game Theory suggests that beliefs determine social preferences, Giaccherini and Ponti (2018) found empirical evidence that social preferences determine beliefs. I was mainly interested on the impact that gender possibly has on distributional preferences, measured by the distributional parameters α and β, and the effect of gender on subjective beliefs. I found that gender has a positive effect on α and β, which measure respectively aversion from disadvantageous inequality and aversion to advantageous inequality. This means that women in the subject pool of this experiment might be, at least to a certain extent, more averse to inequality than men. However, this positive effect is not statistically significant for both parameters and it remains insignificant even when I add the variable "age" into the model. The only statistically significant effect I found is the positive one that age has on β. This means that as experimental subjects get older, they become more averse to advantageous inequality. Finally, I found that the effect that gender has on subjective beliefs is also not statistically significant, even when the variable "age" is added to the model.

I believe that research in Behavioral Economics will continue to expand and I hope that more experimental studies on social preferences and subjective beliefs will be carried out.

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