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The Responder Behaviour in the Ultimatum Game: an Analysis from a Lablike Experiment

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Anno Accademico 2019/2020

It is my honour to dedicate this space of my work to the people who have contributed to its realization with their constant support.
First, a special thanks to my thesis advisor Professor Luca Panaccione and to Professor Lorenzo Ferrari, for their indispensable advice and for the knowledge transmitted throughout the writing of this work.
I am infinitely grateful to my parents and my grandparents for providing me with unfailing support and continuous encouragement throughout my years of study.

Contents

1 The Ultimatum Game: from Rationality to Fairness **4**

1.1 The Theoretical Model with Discrete Offers 5

1.2 The Theoretical Model with Continuous Offers 8

1.3 Extensions of the Basic Ultimatum Bargaining Game 9

1.3.1 Two-Period, Alternating-Offer Game 10

1.3.2 Infinite-Period, Alternating-Offer Game 13

1.4 The Experimental Analysis of Güth et Al. (1982) 16

1.4.1 Easy Games 17

1.4.2 Complicated Games 22

2 Ultimatum Game: a Selective Survey of the Literature **28**

2.1 Ultimatum Game: Anomaly or Rule? 29

2.2 Experimental Evidence on Equity in Bargaining Games 32

2.2.1 Auctioning the Right to Play 32

2.2.2 Multi-Period Ultimatum Games and Behavioural Fallout 35

2.3 Ultimatum and Dictator Games: Property Rights and Other Regarding Preferences 39

2.4 The Dynamics of Responder Behaviour 45

2.5 Intercultural Differences in Responder Decisions 48

3 The Experiment **50**

4 Data Analysis **52**

4.1 Descriptive Statistics and Preliminary Evidence 52

4.1.1 Demographics 53

4.1.2 Proposer Demand in Current and Previous Period 54

4.2 Econometric Analysis: Panel Logistic Regression 58

5 Discussion **63**

6 Conclusion **65**

List of Figures

1 Ultimatum Game with $c = 2$ 6
2 Ultimatum Game with infinite set of possible agreements 8
3 Two-period, alternating-offer game 12
4 Infinite-period, alternating-offer game in which player 1 makes the first offer 15
5 Complicated Games with low payoff - Players' choices 26
6 Complicated Games with low payoff - Indifference curves 26
7 Complicated Games with high payoff - Players' choices 27
8 Complicated Games with high payoff - Indifference curves 27
9 Acceptance rate as a function of experience 47
10 Probability of Response for Proposer Demand median in current period 56
11 Frequency of Acceptance per Round 57

List of Tables

1 Naive decision behaviour in easy games . . . 18
2 Experienced decision behaviour in easy games . . . 20
3 Consistency of payoff demand in easy games . . . 21
4 Decision behaviour in complicated games with low payoffs . . . 23
5 Decision behaviour in complicated games with high payoffs . . . 24
6 Güth and Tietz, Auction winners - 1st game . . . 33
7 Güth and Tietz, Auction winners - 2nd game . . . 33
8 Güth and Tietz, Auction winners - 3rd game . . . 34
9 Ochs and Roth, second round subgames - Games 1-3 . . . 37
10 Ochs and Roth, second round subgames - Games 4-6 . . . 37
11 Ochs and Roth, second round subgames - Games 7-10 . . . 37
12 Ochs and Roth, Third round subgames - Games 1-3 . . . 38
13 Ochs and Roth, Third round subgames - Games 4-6 . . . 39
14 Ochs and Roth, Third round subgames - Games 7-10 . . . 39
15 Descriptive statistics . . . 53
16 Acceptances and rejections . . . 54
17 Proposer Demands and Responses in detail . . . 55
18 Panel Logistic Regression Model: effects on acceptance rate . . . 61

1 The Ultimatum Game: from Rationality to Fairness

The Ultimatum Game is the simplest non-cooperative bargaining game used in experimental economics to study human behaviour in bargaining situations. This game was first studied experimentally by three German economists, Werner Güth, Rolf Schmittberger, and Bernd Schwarze at the University of Cologne in 1982. (Güth, Schmittberger, and Schwarze, 1982)

The Ultimatum Game (henceforth UG) is a game in which two players interact to decide how to divide a monetary amount between them. More specifically, one player, the Proposer, is provisionally endowed with a monetary sum. The Proposer is asked to divide this sum of money with another player, the Responder. The latter has the possibility of accepting or rejecting such distribution. If the Responder accepts the offer, they will both receive the sum established by the proponent beforehand. If the Responder refuses, both players receive nothing.

The Responder observes the offer of the Proposer and both players know in advance the consequences of the Responder's choice. For this reason, UG is a game with perfect information. Moreover, such a game is defined with complete information since it is a decisional situation in which knowledge about each player is shared with all the others. Thus, players are aware of the strategy space (or strategy set) of each player and the utility that each strategy has for each player.

In addition, each agent in UG must choose the option that maximizes his final payoff, i.e. players are endowed with perfect rationality.

Following game theory, a finite game in extensive form with complete information and perfect rationality of players as UG, can be studied using a solution method called backward induction. It allows to find the subgame perfect Nash equilibrium, starting from the "end" of the game tree, and working "back" on the tree solving for optimal behaviour at each node. More specifically, it consists of first identifying oneself with the last player to move, analyzing his rational move and, from the latter, progressively going "backwards" to the previous choices of the other player, until the most rational strategic iteration of the game is completely rebuilt. According to this argument, it is the Proposer in UG who anticipates the Responder's choice in second stage in order to make the best possible offer, which maximizes his or her utility.

The result of this theory implies that the one who makes the offer gives the other player the smallest positive amount of the sum to be divided, to maximize his utility.

Nevertheless, comparing empirical data of Güth et al.'s experiments with the predictions of theoretical models, some discrepancies have been observed. In fact, experimental results have highlighted that individuals do not always behave according to the equilibrium solution, but they can deviate from the optimal decisions. This is where the dualism between descriptive theory and normative theory is investigated. The former tries to find out how decisions are taken in different operational contexts; the latter analyses the way decisions should be taken by referring to ideally rational agents.

1.1 The Theoretical Model with Discrete Offers

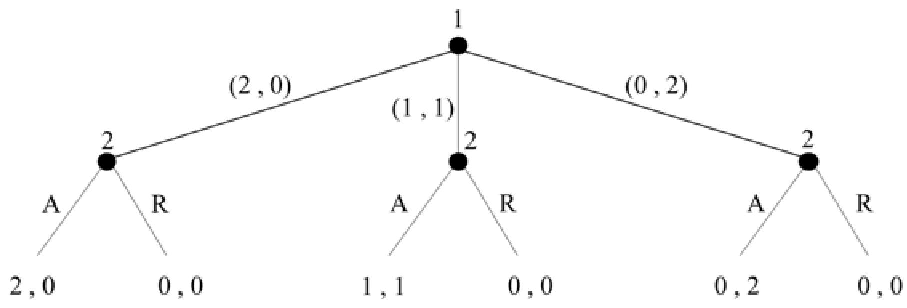
It is useful to study the UG in an abstract setting in which only two players, 1 and 2, negotiate how to divide in indivisible units a given positive amount c between themselves. It refers as an ultimatum because player 1's offer restricts the set of possible outcomes to only two results, among which player 2 can choose. Thus, if player 1 wants to propose an ultimatum to player 2, he only has to determine his own demand, d_1, which consists of the entire sum c minus the offer made to player 2, which will be called x. So, player 1's demand is the following:

$$d_1 = c - x \tag{1}$$

Player 2 can decide whether to accept or reject the offer: in the first case, player 1 will have $c - x$ as payoff, and player 2 gets x; the second case implies payoff 0 for both players. In case of rejection, the payoff (0.0) is called the disagreement point, because it is the payoff vector that result when players fail to reach the agreement. An example of UG with discrete offers in which $c = 2$ is illustrated in Figure 1 in its extensive form, a detailed representation of the sequential structure of decision-making problems faced by players in a strategic situation.

It can be said that UG with discrete offers has an finite number of subgames. In game theory, given an extensive form game, a subgame is defined as any part of the game tree that starts at a given node, contains all the nodes that are its successors and contains all the nodes that are successors of any node that it contains. (Osborne and Rubinstein, 2020, pages 249-254)

Figure 1: Ultimatum Game with $c = 2$



Source: Osborne and Rubinstein, 2020, pages 249-254

The theoretical solution of a one-round bargaining game with discrete offers is intuitive. Since this game has a finite horizon, it can be used backward induction to find its subgame perfect equilibria (i.e SPNE), namely those equilibria which constitute a Nash equilibrium in every subgame of the original game. Nash equilibrium means that no player can profitably deviate, given the actions of the other players.

It is known that each of the strategies of player 2 specifies its reaction to each possible proposal of player 1. So, for player 2, the optimal strategy consists of accepting the proposal only if $d_1 < c$, so that player 2 can receive a non-negative payoff. (Watson, J. 2002)

Therefore, considering each subgame, any offer x made by player 1 allows player 2 to accept it, given $x > 0$.

Now consider $x = 0$, so the case in which player 1's offer is zero. If player 1 asks $d_1 = c$, player 2 can reject the offer and this rejection is an optimal strategy as well as its acceptance (in both cases player 2's payoff would be 0, so he is indifferent between the two strategies).

According to this argument, player 2 has only two possible rational strategies, depending on the scenario that arises: in the case of $x = 0$, he can accept all offers; in the case of $x > 0$, he can accept all offers of $x > 0$ and reject the offer of $x = 0$.

Following the backward induction procedure, it is now necessary to determine the optimal strategy of player 1 to find the SPNE of the game.

If player 2 accepts all offers, the optimal strategy of player 1 will be $x = 0$, i.e. keeping the entire amount c ($d_1 = c$) for himself.

If player 2 refuses $x = 0$ and accepts all offers $x > 0$, then player 1 would get 0 in case player 2 refuses, and $c - x$ in case player 2 accepts all offers with $(c - x) < c$.

The interest of player 1 is choosing the smallest possible monetary unit x, which is $x = 1$. So, the game has two subgame perfect equilibria: the first one in which player 1 proposes that he gets all c and player 2 agrees to all proposals; the second one in which player 2 plans to reject only the proposal that gives him no units and player 1 proposes that player 2 gets exactly one unit. (Rubinstein and Osborne, 2020) The correspondent game payoffs would be (c, 0) in the first case and (c-1, 1) in the second one.

In order to make this solution clearer, it is good to compare the division to that of a "bargaining pie", divided into indivisible c slices that player 1 must decide how to divide between himself and player 2. In the case of the subgame perfect equilibria mentioned above, player 1 would keep the whole "pie" for himself or, knowing that the rejection of the offer by player 2 implies "eating nothing", he would be willing to give up just a single slice. On the other hand, in the first case, player 2 would be indifferent between not having anything or having offered 0 slices of "pie" while in the second case, having only one slice would still improve his position.

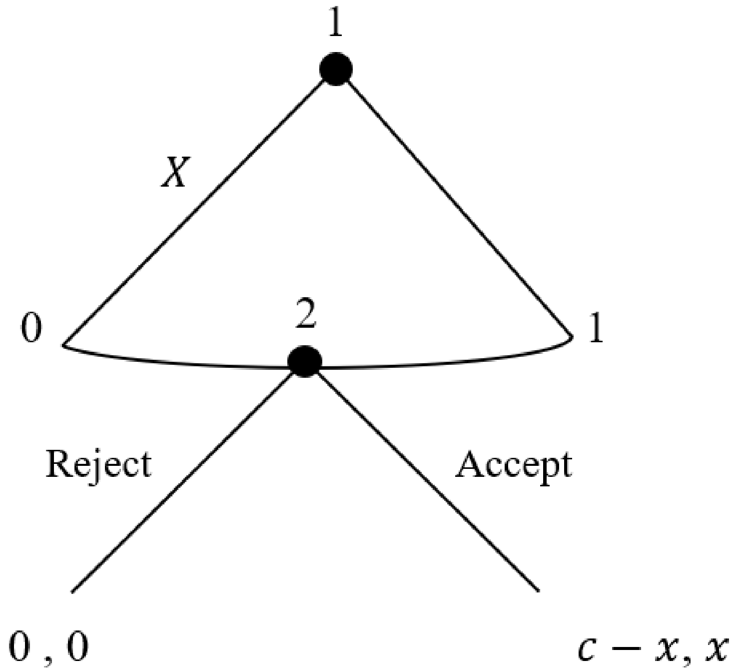
Therefore, it is possible to say that the game has multiple Nash equilibria. For any allocation, the game has such a Nash equilibrium that player 1 proposes the allocation and player 2 accepts that allocation and rejects the others. Also, the pair of strategies in which player 1 keeps the whole sum for himself is a Nash equilibrium, which produces disagreement.

1.2 The Theoretical Model with Continuous Offers

So, what if the "bargaining pie" is infinitely divisible? It can be said that this UG has an infinite number of subgames which start from any possible offer of the Proposer.

In the abstract setting analysed, it is possible to argue that player 1 as a infinitely set of strategy's actions and player 2 has infinite decision nodes, each of which starts a subgame that ends with player 2's own decision. Player 2, in fact, observes the decision of player 1. Every offer that player 1 could make is a set of information consisting of a single node.

Figure 2: Ultimatum Game with infinite set of possible agreements



This time the extensive form of the game consists of a cone illustrated in Figure 2, which indicates the infinite actions that player 1 has in front of him. Player 1's set of strategies in this UG with continuous offers is X, and each strategy of player 2 is a function that for each $x \in X$ specifies either accepting or rejecting the offer.

As mentioned in paragraph 1.1, also in this case player 2 has only two possible rational strategies: if $x = 0$, he can accept all offers; if $x > 0$, he can accept all offers of $x > 0$ and reject the offer of $x = 0$. Moreover, $d_1 < c$ is the condition that player 2 obviously accepts player 1's proposal. In fact, this is the situation where the player takes a non-negative payoff.

As far as player 1's decision is concerned, his interest is choosing the smallest possible monetary unit, which is denoted by ε ($\varepsilon > 0$). The optimal demand of player 1 would be $d_1 = c - \varepsilon$ with $\varepsilon > 0$, which means that player 1 can ask for almost the whole "pie" itself, leaving only a crumb of the "pie" c for player 2. Nevertheless, if the offers are continuous, there will always be a better proposal for player 1, i.e. it is always possible to find a smaller ε. Thus, given ε, $(1 - \frac{1}{2}\varepsilon, \frac{1}{2}\varepsilon)$ is better and so on. (Rubinstein and Osborne, 2020, pages 264-266)

Hence, Player 1 has no incentive to move from $d_1 = c$ and it can be said that the unique SPNE of the game is the pair of strategies in which player 1 offers 0 and player 2 accepts all offers. The equilibrium payoffs are (c, 0), i.e. player 1 gets the entire monetary amount c while player 2 gets 0.

1.3 Extensions of the Basic Ultimatum Bargaining Game

The Ultimatum Game described so far is the simplest version of a bargaining model, in which the Proposer makes his offer and the Responder is aware that his decision will make the game stop, earning something or leaving both with nothing.

Since it is so simple, it has some inherent controversies: for example, the finite game horizon allows players to assess future results in a different way, on which both the nature of the punishment and the amount offered depend; moreover, in many real contexts, the parties alternate by making offers until one is accepted.

Among the different ways in which the theory can be expanded, one of the most realistic is to explicitly model multiple offers and counter offers of the parties over time. Offers and counteroffers take time, where one party can wait a long time before deciding to accept or counter-propose. In addition, engaging in a bargaining process that takes time means asking a person to give up productive opportunities during that negotiation period. (Watson, 2002, pages 244-273)

Hence, most people can be described as impatient, i.e. they prefer short negotiation periods, and do not weigh the future in the same way as the present. How a person discounts the future can influence his or her negotiating position. Nevertheless, it is reasonable to expect that more patience leads to a greater share of the surplus than impatience. (Watson, 2002, pages 244-273)

For the reasons stated above, it is crucial to introduce a discount factor $\delta \in (0, 1)$ for each player in the infinitely repeated games to understand players' payoffs. The discount factor $\delta = \frac{1}{(1+r)}$ is the value today of a unit of currency to be received one period later, where r is the interest rate per period.

Further, each player discounts the future by the discount factor; a deal reached in period t that gives one player a share of c is equivalent to giving him $\delta_t c_t$ today. The discount factor is generally a number between 0 and 1, where larger values correspond to a greater patience.

In the UG, the last period of game directly affects the players' strategic considerations. So, this is one of those games that involve a limited number of repetitions but is better analysed as infinitely repeated games. If not very close to the end of the game, the player plays almost ignoring the final round, and his thread of reasoning is then shaped by the infinitely repeated game.

The existence of a finite horizon can have a crucial effect on individuals' choices: a punishment phase which lasts for a limited period ensures that players will return to pursue the best possible result in next periods. (Watson, 2002, pages 244-273)

1.3.1 Two-Period, Alternating-Offer Game

To facilitate the study later, address the case where $T < \infty$. First analyse the case where $T = 2$. Two players have to split a sum c between them, which even this time is normalised to 1. The players alternate themselves in making the offer, starting with player 1.

In the first-round $t = 1$ player 1 is endowed with the entire amount and is responsible for dividing it between himself and player 2. Player 1 makes the offer x_1 and Player 2 can decide whether to accept the allocation proposed by player 1 or reject it. In the first case, the game ends at period t_1 with player 1 receiving $1 - x_1$ and player 2 obtaining x_1. In the second case, instead of both receiving nothing, the two players enter a new round (or period) $t = 2$ of the game in which the roles are reversed. Player 2 makes a counteroffer x_2, which player 1 either accepts or rejects. The latter will be multiplied by the players 'discount factors to compare payoffs received in the first period with those received in the second period. More specifically, as shown in Figure 3, if player 1 accepts player 2's offer in the second period, then player 1 gets $\delta_1 x_2$ and player 2 gets $\delta_2(1 - x_2)$. If player 1 rejects player 2's offer, then the game ends and both players obtain 0.

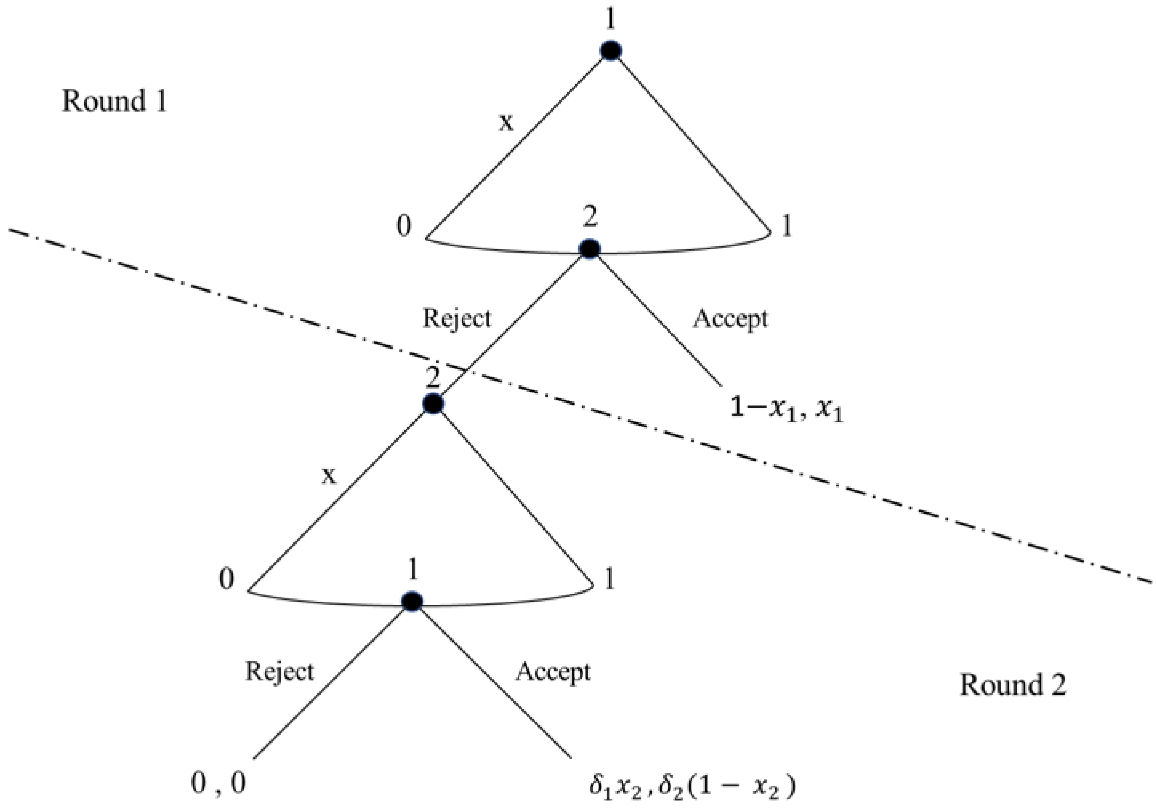
Note that the two-period, alternating-offer game consists in the repetition of the basic UG structure. Basically, if the offer is rejected in the first period and the analysis begins in the second period, the game will again be a standard UG with the reversed roles. In fact, in an SPNE player 2 will offer zero to the other player and he will keep the full amount $c_2 = 1$. The offer will then be accepted by player 1. If one wants to write this subgame perfect equilibrium in terms of payoffs of the first period, these values are $\delta_1 * 0$ for player 1 and $\delta_2 * 1$ for player 2.

Given this assumption, it is essential to study the first round of this game with $T = 2$ to understand how player 1 will make the offer at the beginning of the entire game. Player 1 knows that if his offer is not accepted, in the next period player 2 will demand everything. Player 1 has to make an offer x_1 in period $T = 1$ greater than or equal to δ_2 to player 2 in order for player 2 to accept the offer. In contrast, rejection is the only rational choice if $x_1 < \delta_2$. Then, player 1 should offer the least amount that player 2 would accept, that is $x_1 = \delta_2$, so he gets $1 - \delta_2$.

As in the basic UG, the only Nash equilibrium has player 2 accepting the offer that makes it indifferent; in addition, player 1 makes this offer. So, there is a unique SPNE of the game for $T = 2$, where player 2 accepts any initial offer that gives him a value greater or equal to δ_2 and rejects the offer if this value is lower than δ_2. Otherwise, player 2 always offers $x_2 = 0$ at the beginning of the second period, and player 1 accepts any offer in the second period. The equilibrium yields a payoff of $1 - \delta_2$ to player 1 and δ_2 to player 2.

As previously mentioned, the discount factor can underline how patient an individual is: in particular, considering the bargaining period $T = 2$, it is possible to notice the positive relationship between patience and bargaining power. For example, the impatience of player 2 is highlighted by his discount factor, which if smaller, makes the equilibrium payoff close to zero. On the contrary, player 1 obtains most of the surplus to be divided. (Watson, 2002, pages 244-273)

Figure 3: Two-period, alternating-offer game



This relationship between bargaining power and patience is enhanced in more general cases.

Consider a general T, $T < \infty$ where players take turns in making offers until an offer is accepted or until periods T have elapsed. Note that when considering time equal to T, it is important to know whether the periods are even or odd: in the first case, player 2 has the last offer in such a game; in the second case, player 1 has the last offer.

It is important to underline that to achieve a common value equal to 1, the equilibrium of the game of alternating offers involves the agreement made in the first period. Indeed, if an agreement is reached only in the second period, then the common value will be $\delta_1 x_2 + \delta_2(1 - x_2)$, which is strictly less than 1. It is here that one can talk about "shrinking cake". The common value would have been zero if no agreement had been reached in both periods. Thus, the result of the subgame perfect equilibrium is efficient. The same argument can be applied to games that take place over a time horizon T: again, to reach a common value equal to 1, the equilibrium is characterized by an immediate agreement.

1.3.2 Infinite-Period, Alternating-Offer Game

As regard as infinitely repeated game is concerned, consider an UG played an infinite number of times and that it is defined by $T = \infty$. From a strategic point of view, a game with an infinite number of rounds is comparable to a game where players do not know how many rounds they are playing for. Infinitely repeated games cannot be solved with backward induction because there is no "last round" from which start them.

The games studied so far have been designed to make it much easier to find a perfect equilibrium in a game that takes place on an infinite horizon.

So, consider again the previous abstract scenario, but this time with infinite game periods. The bargaining consists of repeated exchanges of offers. Formally, the model studied consists of a pre-specified set $T = (t_1, t_2, t_3...)$ with $T \to \infty$ and for each $t \in T$ an event takes place.

Even this time, two players must split a sum c between them, which is normalised to 1. More specifically, at time tn, player 1 can propose a split $(1 - x_{t_n}, x_{t_n})$ with $x_t > 0$ to player 2, which can accept or refuse. If player 2 accepts, the game ends; if he refuses, the game continues at time t_{n+1}, where he will propose a split $(x_{t_{n+1}}, 1 - x_{t_{n+1}})$ to player 1. Once player 2 makes a proposal, player 1 can accept or reject, and so on ad infinitum. Unlike the UG in which rejecting x implies conflict and 0-payoffs for both parties, in this case the bargaining time is infinite.

Player 1 makes the first offer as shown in Figure 4. As a result, every subgame that starts in an odd period resembles every other subgame of this type as well as every game in an even period resembles every other subgame of this type.

How to find a stationary equilibrium of an infinite time game? Consider, now, x_2 as the offer that player 1 makes in odd periods, i.e. in periods when he proposes a division of the monetary sum to player 2. Likewise, always consider x_1 as the offer that player 2 would make in even periods.

Assuming that these offers are accepted in equilibrium, it is possible to write continuation values from the point of view of each period, i.e. not discounted at the beginning of the game, such that: the continuous payoff vector from any odd period is $1 - x_2$, x_2, and the continuous payoff vector from any even period is $x_1, 1 - x_1$.

The equilibrium of this game is when player 1 puts player 2 in the position of being indifferent between accepting the offer and rejecting it to move on to the next period in which he will make the counteroffer. Player 2's payoff if he accepts the offer would be x_2, which discounted to the current period is $x_2\delta_2$. In case of rejection, player 2 would have a continuation payoff of $1 - x_1$ from the beginning of the next period, which is $\delta_2(1 - x_1)$ in terms of the current period payoff. The equation that makes player 2 indifferent between accepting and rejecting is $\delta_2(1 - x_1) = x_2$.

Since this equation can be applied to both players, one has the following system of equations:

$$\delta_1(1 - x_2) = x_1 \tag{2}$$

$$\delta_2(1 - x_1) = x_2 \tag{3}$$

By solving these equations, one obtains:

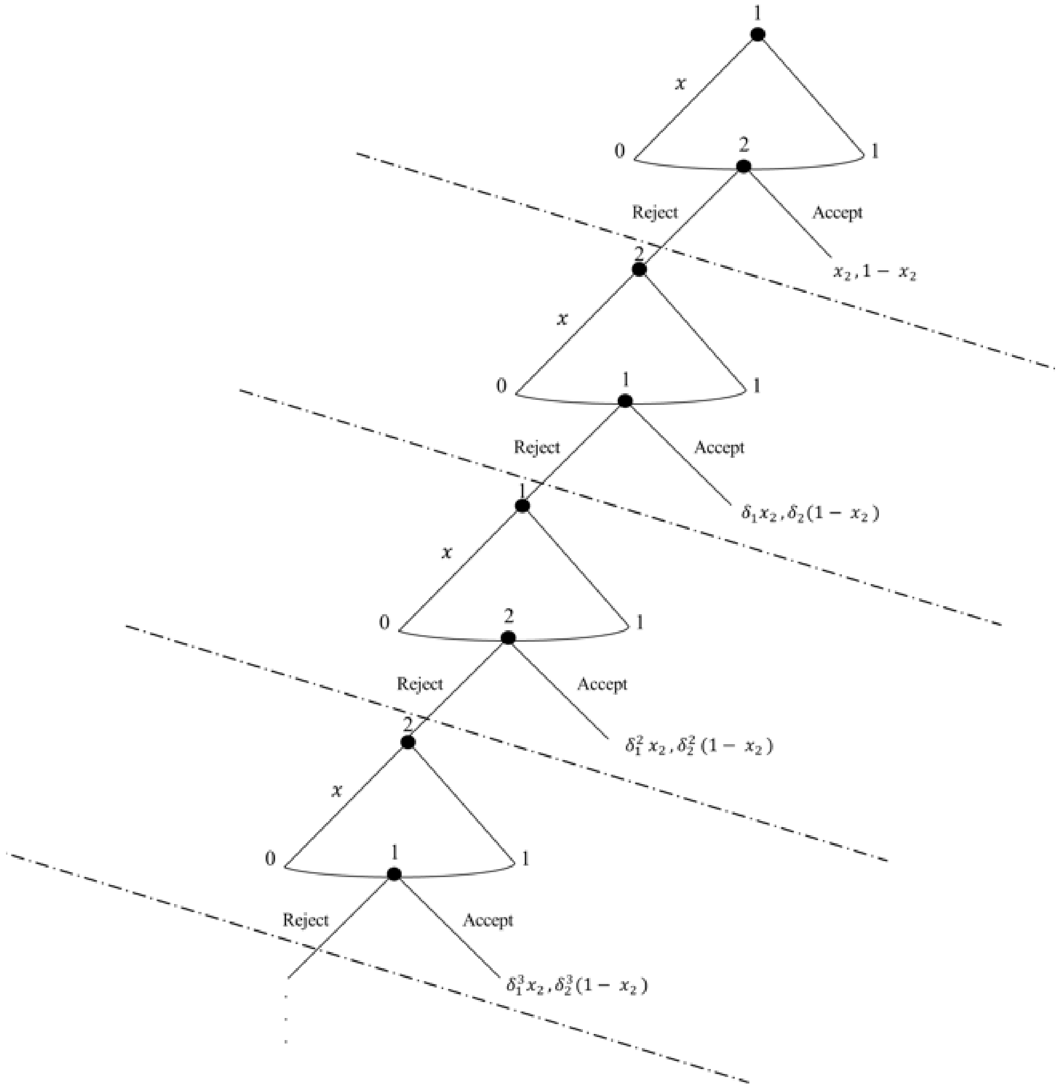
$$x_1 = \frac{\delta_1(1 - \delta_2)}{1 - \delta_1\delta_2} \tag{4}$$

$$x_2 = \frac{\delta_2(1 - \delta_1)}{1 - \delta_2\delta_1} \tag{5}$$

Then one can check that the following outcome is the unique subgame perfect equilibrium in the infinite-period game. The equilibrium is characterized by an agreement in the first period and produces a return of $\frac{(1-\delta_2)}{1-\delta_2\delta_1}$ for player 1 and $\frac{\delta_2(1-\delta_1)}{1-\delta_2\delta_1}$ for player 2. (Rubinstein, 1982)

The infinite period bargaining game with alternating offers illustrated above is known as Rubinstein model. It states that: "Under assumptions, every bargaining game of alternating offers has a unique subgame perfect Nash equilibrium. In this equilibrium, an agreement is reached immediately and players' utilities are satisfied." (Binmore, Osborne, and Rubinstein, 1990) Hence, player 1 proposes to player 2 exactly the present value that he will get when is his turn and accepts an offer from player 2 that is at least as good as what he gets if he continues the game.

Figure 4: Infinite-period, alternating-offer game in which player 1 makes the first offer



The economic reason that "supports" this equilibrium is as follows: players agree to maximize their payoffs in the first period, while the actions to be taken in the second period are of two types: a "punishment" if player 1 does not keep the agreement, a prize if it is fair. The "prize" is the best Nash equilibrium of the stage game, i.e. the base game, whose repetitions constitute an extensive form repeated game. In this case, strategies consider the history of the game and reputation of players.

It is therefore possible to say that, given a stage game with a certain equilibrium in pure strategies, a discount factor $\delta^{'}$ exists such that, for every $\delta \geq \delta^{'}$, the infinitive period bargaining game admits a subgame perfect equilibrium with higher payoffs (at least) for each player than those obtained in the Nash Equilibrium of the stage game. This is the so-called Folk Theorem, the result of games with an infinite time horizon. (Osborne and Rubinstein, 1994)

In other words, in infinite-period bargaining game, if players are patient enough - i.e. if they consider future winnings to be relevant (δ tends to 1) - any outcome that dominates (weakly) Nash equilibrium of the stage game can be part of a subgame perfect equilibrium. A type of strategies often used in this type of game – called trigger strategies - replicate in this context the idea that fair behaviour is rewarded in future, while deviations from an agreement are punished. So, Rubinstein (1982) showed that the more patient player 1 is the more successful he will be.

Furthermore, the special case $\delta = \delta_1 = \delta_2$ with $0 < \delta < 1$ with $\delta \to 1$ the solution agreement approaches the equal split of c. (Watson, 2002, pages 244-273)

1.4 The Experimental Analysis of Güth et Al. (1982)

The type of bargaining between individuals that takes place in the UG makes it special. The peculiarity of this game is that each player is involved in a 1-person bargaining game, i.e. Ultimatum bargaining games are not shaped by the interdependence of the players' decisions, but only by the anticipation of the players' future choices. Therefore, it can be argued that the specialty of the UG is not about computation of the subgame equilibrium points, but about analysing the different aspects of human behaviour in the context of a bargaining situation. (Güth, Schmittberger, and Schwarze, 1982)

The pioneers of the experimental analysis of the UG are 3 German economists, Werner Güth, Rolf Schmittberger, and Bernd Schwarze, who investigated about this phenomenon at the University of Cologne. The participants involved were students with no familiarity with game theory, graduated in economics, who attended a seminar to obtain credits for the final exams. The experiments implemented by Güth et al. (1982) have been divided into two subgroups. The core of the first group of experiments is the simplest UG model, where two players have to decide how to divide a certain amount of money. Instead, the second group of experiments is based on a more complicated game, where two players have to distribute a certain amount of black and white chips between them, which are not of equal value for both. Hence, the different name of the two subgroups: the first is called “easy games”, the second “complicated games”. In both groups, players are informed in advance of the rules of the game. In addition, Proposers and Responders are matched randomly, to prevent players from getting to know each other; players are seated in the same room but at a certain distance, to avoid verbal communication and to ensure transparency to all those who were part of it.

1.4.1 Easy Games

In the easy games, the players designated as player 1 have to choose the amount a he wants to leave to player two. Player 1 has to write down this amount on a form, which also informs him of the amount c to distribute. This form is then collected and distributed randomly to the group of players 2. Once the decision of player 1 is known, player 2 must decide whether to accept the offer or reject it. For each form there were two tickets, respectively of player 1 and player 2. On each ticket there was also a capital letter, indicating the game, and the number of the player. Each ticket had to be shown to get payment.

In the first experiment, to which Güth et al. refer as “Naive experiment”, the total amount to be shared between the two players varies from 4 to 10 DM. In Table 1, the following data are shown: the games played, for a total of 21, called with a letter from A to U; the amount to be distributed; the demand of player 1; the decision of player 2, equal to 1 in case of acceptance, 0 in case of refusal. Since the absolute amount to be divided is different in the various experiments, the use of percentages can standardize the comparison between the questions and make it intuitive to understand. Hence, considering the “bargaining pie” equal to 100% , it is possible to say that the slice of the “pie” that player 1 asks for himself is on average 64.98% , thus leaving player 2 with 35.02% of it. The mode of demand distribution is equal to half of the bargaining pie. The smallest slice of “pie” requested by player 1 is also half of the “pie” itself, while the maximum is 100% of it. Only on two occasions has the proposal been rejected: in the case of game Q, when the offer is equal to 20% of the pie - the Proposer asked 4.8 out of 6 DM for himself - and in the case of game T, when the offer is equal to 0.

Table 1: Naive decision behaviour in easy games

Game	c (DM)	d_1 (DM)	Decision of player 2	d_1 (%)
A	10	6.00	1	60.00
B	9	8.00	1	88.89
C	8	4.00	1	50.00
D	4	2.00	1	50.00
E	5	3.50	1	70.00
F	6	3.00	1	50.00
G	7	3.50	1	50.00
H	10	5.00	1	50.00
I	10	5.00	1	50.00
J	9	5.00	1	55.56
K	9	5.55	1	61.67
L	8	4.35	1	54.38
M	8	5.00	1	62.50
N	7	5.00	1	71.43
O	7	5.85	1	83.57
P	6	4.00	1	66.67
Q	6	4.80	0	80.00
R	5	2.50	1	50.00
S	5	3.00	1	60.00
T	4	4.00	0	100.00
U	4	4.00	1	100.00

Source: Güth et al. (1982), table 4, page 375

After the first experiment, a second one took place after a week, in which player 1 had to face a different opponent and he had to distribute a different amount. This "Experienced experiment", shown in Table 2 has different results from the previous one.

Always looking at the data as part of a "bargaining pie", it can be said that the experience has slightly changed the decision of both players. In particular, player 1 proved to be a bit more consistent with equilibrium prescription than the previous time, asking about 69.05% of the "pie" on average, although no one asked for 100% of the "pie" this time. In fact, the highest demand is equal to 99.80%, the minimum to 50%. Moreover, the mode of demand distribution is equal to 75% of the bargaining pie this time. In addition, player 2 has "punished" player 1 more than before: 6 out of 21 cases of rejection of player 1's offer are in this second experiment, unlike the first experiment where there are only 2 out of 21 cases of rejection. Of these 6 cases, 4 are in a range between 16 and 25%, one is very close to zero - the Proposer asked for 99.80% of the pie - and one, instead, is close to the threshold of equity - about 43% of the pie.

Furthermore, a third experiment was carried out in which were asked to 37 subjects to indicate how much they would have demanded if they were Proposer or Responder, to analyse the behaviour and the consistency of a subject's demand. The total amount to be divided is 7 DM.

As shown in Table 3, the second column shows the subject's demand as player 1, the third column shows the demand as player 2. In the fourth column there is the sum of the two demands: if the sum is greater than 7, it is indicated with a "+" in the fifth column; if the sum is less than 7, it is indicated with a "-"; if equal, with 0. So, 15 out of 37 subjects have consistent demands. Instead, 17 out of 37 subjects are willing to accept demands from player 1 that are higher than their aspiration level. 5 subjects out of 37, as player 1, are willing to offer less to player 2 than they, as player 2, were willing to accept.

In addition, the average player 1's demand is much lower than in the previous two experiments. Player 1 offered a higher amount to player 2, equal to 58.10%. It is undoubtedly evident that - except in the case of the 5 subjects mentioned before - player 1 is more "generous" towards player 2 than in the previous experiments due to

Table 2: Experienced decision behaviour in easy games

Game	c (DM)	d_1 (DM)	Decision of player 2	d_1 (%)
A	10	7.00	1	70.00
B	10	7.50	1	75.00
C	9	4.50	1	50.00
D	9	6.00	1	66.67
E	8	5.00	1	62.50
F	8	7.00	1	87.50
G	7	4.00	1	57.14
H	7	5.00	1	71.43
I	4	3.00	0	75.00
J	4	3.00	0	75.00
K	5	4.99	0	99.80
L	5	3.00	1	60.00
M	6	5.00	0	83.33
N	6	3.80	1	63.33
O	10	6.00	1	60.00
P	9	4.50	1	50.00
Q	8	6.50	1	81.25
R	7	4.00	0	57.14
S	6	3.00	1	50.00
T	5	4.00	0	80.00
U	4	3.00	1	75.00

Source: Güth et al. (1982), table 5, page 375

Table 3: Consistency of payoff demand in easy games

Index of subject	d_1 (DM)	d_2 (DM)	*Consistency* (%)
1	4.00	3.00	0
2	3.50	2.50	-
3	3.50	3.50	0
4	3.50	3.50	0
5	4.00	3.00	0
6	3.50	3.50	0
7	4.00	3.00	0
8	5.00	3.50	+
9	3.50	3.50	0
10	3.50	3.50	0
11	3.50	3.50	0
12	3.50	2.00	-
13	5.00	1.00	-
14	3.50	1.00	-
15	3.50	5.00	+
16	4.00	2.50	-
17	4.00	3.00	0
18	4.00	3.00	0
19	5.00	1.00	-
20	6.99	0.01	0
21	3.50	2.00	-
22	4.00	2.50	-
23	4.00	3.50	+
24	3.50	3.00	-
25	5.00	2.00	0
26	4.00	1.00	-
27	3.50	2.00	-
28	4.00	1.00	-
29	3.50	3.00	-
30	3.50	2.50	-
31	4.50	3.50	+
32	4.00	3.00	0
33	4.00	0.10	-
34	3.50	3.50	0
35	4.00	1.00	-
36	7.00	3.50	+
37	4.00	2.50	-

Source: Güth et al. (1982), table 7, page 379

the knowledge of the rules and the performance of the two roles.

1.4.2 Complicated Games

The subgroup related to the complicated game put into practice a different experiment, in which black and white chips were split this time. Those in the role of player 1, in fact, have to divide 5 black and 9 white chips with player 2. These chips assume a different value for the two players: for player 1, all chips assume the same value, equal to 2 DM; for player 2, the black chips are worth 2 DM and the white ones half, so 1 DM. Player 1 must create two bundles: the first (i.e. "bundle I") given by m_1 black and m_2 white chips, the second (i.e. "bundle II") given by $(5 - m_1)$ black and $(9 - m_2)$ white chips. Player 2 has to choose between the two bundles, and the discarded one goes to Player 1. The instruction procedures of the game and the rules established in the experiment were similar to the easy games as well. While the analysis of the "easy game" was carried out in a theoretically in-depth manner in the previous chapter, the so-called "complicated game" differs from the classic UG and the decisions rationally made by the players are not intuitive in the same way.

This complicated game is called "divide and choose", or DC. Knowing that individuals tend to maximize their utility, the SPNE, based on such preferences, are calculated by the authors as follows. Player 1 splits the chips into black and white, creating "Bundle I" with 5 black and 0 white chips (5, 0) and "Bundle II" with 0 black and 9 white chips (0, 9). If Player 2 chooses Bundle I, the payoffs of the players are (18, 10). If Player 2 takes the whites, the payoffs are (10, 9). The opposite situation is that Player 1 creates "Bundle I" with 0 black and 9 white chips (0, 9) and "Bundle II" with 5 black and 0 white chips (5, 0). If Player 2 chooses Bundle I, the payoffs of the players are (10, 9). If Player 2 takes "Bundle II", the payoffs are (18, 10).

So, Player 1 has two optimal choices (two "Bundle I"): one is (5.0), the other is (0.9). Consequently there are two "Bundle II": the first is (0.9), the second is (5.0). In both cases, the payoffs that players get when they choose the best bundle for themselves is the same, that is 18 for player 1 and 10 for player 2, but the way to get it is different.

Moreover, player 1 has comparatively more yield in the first case (18, 10) than in the second (10, 9), while the payoff of player 2 is slightly different in these two cases.

Table 4: Decision behaviour in complicated games with low payoffs

Game	Bundle I		Bundle II		Payoffs (I)		Payoffs (II)		Actual choice
	m_1	m_2	$(5-m_1)$	$(9-m_2)$	Player1 (DM)	Player2 (DM)	Player1 (DM)	Player2 (DM)	
A	5	0	0	9	18	10	10	9	I
B	5	0	0	9	18	10	10	9	I
C	5	2	0	7	14	12	14	7	I
D	3	5	2	4	12	11	16	8	I
E	5	0	0	9	18	10	10	9	II
F	4	5	1	4	10	13	18	6	I
G	5	2	0	7	14	12	14	7	I
H	5	8	0	1	2	18	26	1	I
I	4	3	1	6	14	11	14	8	I
J	5	2	0	7	14	12	14	7	I
K	4	4	1	5	12	12	16	7	I
L	5	0	0	9	18	10	10	9	I
M	4	3	1	6	14	11	14	8	I
N	4	2	1	7	16	10	12	9	I
O	3	3	2	6	16	9	12	10	I
P	5	0	0	9	18	10	10	9	I
Q	5	0	0	9	18	10	10	9	I

Notes. Personal elaboration based on Güth et al. (1982), table 8, page 381. The first column indicates the game; the second and third columns indicate the distribution of chips in the two complementary bundles; the fourth and fifth columns indicate the payoffs of both players if Player 2 chooses the first or second bundle respectively; the last column shows the actual choice of Playing 2.

So, Player 2 can implement a punitive mechanism if Player 1 takes advantage of his favourable bargaining position that comes from the split. (Güth, Schmittberger, and Schwarze, 1982)

The results of the complicated games are shown in Table 4 and 5. They represent respectively the experiment with the same payoffs as the pilot experiment, also called game with "low payoff", and the experiment carried out by the same subjects after one week with "higher payoffs".

In both tables, the "non-rational" choices made by player 2, who chose the bundle that guarantees him a lower payoff, are shown in red. It is in these cases that, at the expense of a lower payoff, player 2 leaves the bundle which gives a lower payoff to player 1 too.

The Exchange box in Figure 5 shows the distribution of the quantities of two goods - black and white chips - in the two bundle in the complicated game with low payoffs, depending on the decision made by player 2. The first Cartesian diagram, the one in the direction of the observer, shows the quantities of black and white chips in one bundle,

Table 5: Decision behaviour in complicated games with high payoffs

Game	Bundle I		Bundle II		Payoffs (I)		Payoffs (II)		Actual choice
	m_1	m_2	$(5 - m_1)$	$(9 - m_2)$	Player1 (DM)	Player2 (DM)	Player1 (DM)	Player2 (DM)	
A	5	0	0	9	18	10	10	9	I
B	5	1	0	8	16	11	12	8	I
C	5	1	0	8	16	11	12	8	I
D	5	0	0	9	18	10	10	9	II
E	5	0	0	9	18	10	10	9	II
F	5	0	0	9	18	10	10	9	I
G	5	0	0	9	18	10	10	9	I
H	3	4	2	5	14	10	14	9	I
I	5	0	0	9	18	10	10	9	I
J	5	0	0	9	18	10	10	9	II
K	4	1	1	8	18	9	10	10	II
L	4	1	1	8	18	9	10	10	II
M	1	8	4	1	10	10	18	9	I
N	0	9	5	0	10	9	18	10	II
O	5	0	0	9	18	10	10	9	II

Notes. Personal elaboration based on Güth et al. (1982), table 9, page 381. The first column indicates the game; the second and third columns indicate the distribution of chips in the two complementary bundles; the fourth and fifth columns indicate the payoffs of both players if Player 2 chooses the first or second bundle respectively; the last column shows the actual choice of Playing 2.

while the second, the one rotated 180°, shows the complementary one. The final result is a double rectangle-shaped graph with two origins. The black points represent the decisions made by player 2 to choose Bundle II while grey points indicate that player 2 has chosen Bundle I. The same is described in Figure 7 for complicated games with high payoffs. Figure 6 and 8 show the indifference curves for both players, respectively red for player 2 and blue for player 1. Thanks to this representation, it is possible to observe which choices have actually maximized the player's utility and which have not: the higher the indifference curve on which the point lies, the higher the player's utility level will be.

Only in very few cases, player 2 has chosen the bundle "lying" on a lower indifference curve than the complementary one. In particular, in the complicated game with lower payoffs, in game O, player 2 chose bundle I (the O^I point in Figure 5), despite having a lower payoff; in game E, he chose bundle II, despite lying on a lower indifference curve. As for the complicated game with higher payoffs, in the games D, E, J, O represented for simplicity by point A in figure 7 because they all have the same partition, it has always been chosen the bundle II (black point in the figure), although it gives a lower payoff.

Overall, complicated games, although less simple in calculations, are perceived as more intuitive by individuals. In most cases, in fact, the choice made corresponds to the one that maximizes player's utility.

Apart from the better prediction of the SPNE than the easy game, the comparison of UG with DC does not provide important information. It led Güth, studying much more complicated bargaining problems, to develop a research program on fair division and to study UG later. In fact, UG is the simplest bargaining situation, but psychologically very rich. Fairness considerations had already been addressed in previous experimental work, but they had not manipulated the game in such a way as to highlight the merits of behavioural theories with respect to rational explanations of choices.

The theoretical predictions shown in the abstract context in Paragraphs 1.1 and 1.2 lead respectively to two rational solutions for UG with discrete offers and one for UG with continuous offers.

If one took this game out of the abstract context, would the same result be achieved?

Güth et al.(1982) have shown that facing real-life choices, individuals do not possess a Von Neumann Morgenstern utility function, i.e. they simply do not react to maximize their utility. Other factors occur in real life that lead individuals to make choices in contrast with the perfect rationality of classical game theory.

Although the intrinsic nature of the experiment leads one to think that an individual who possesses nothing is willing to accept even the lowest possible offer in order to improve his or her position, in real circumstances the concept of fairness takes over. Consequently, the rejection of the proposal - judged unfair by the Responder - is considered the "correct punishment" for the greedy Proposer. At the same time, the Proposer is aware that unfairness could lead the Responder to reject his offer: hence, the Proposer tends to offer relatively equal division than the ones classic game theory suggests.

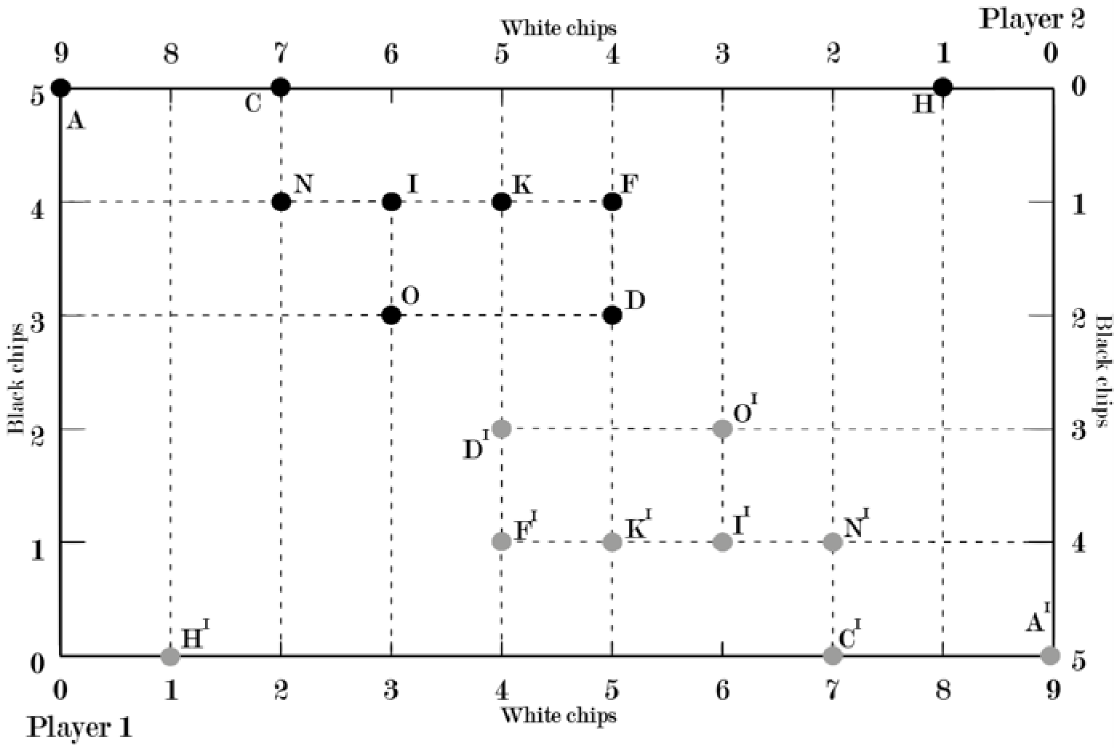


Figure 5: Complicated Games with low payoff - Players' choices

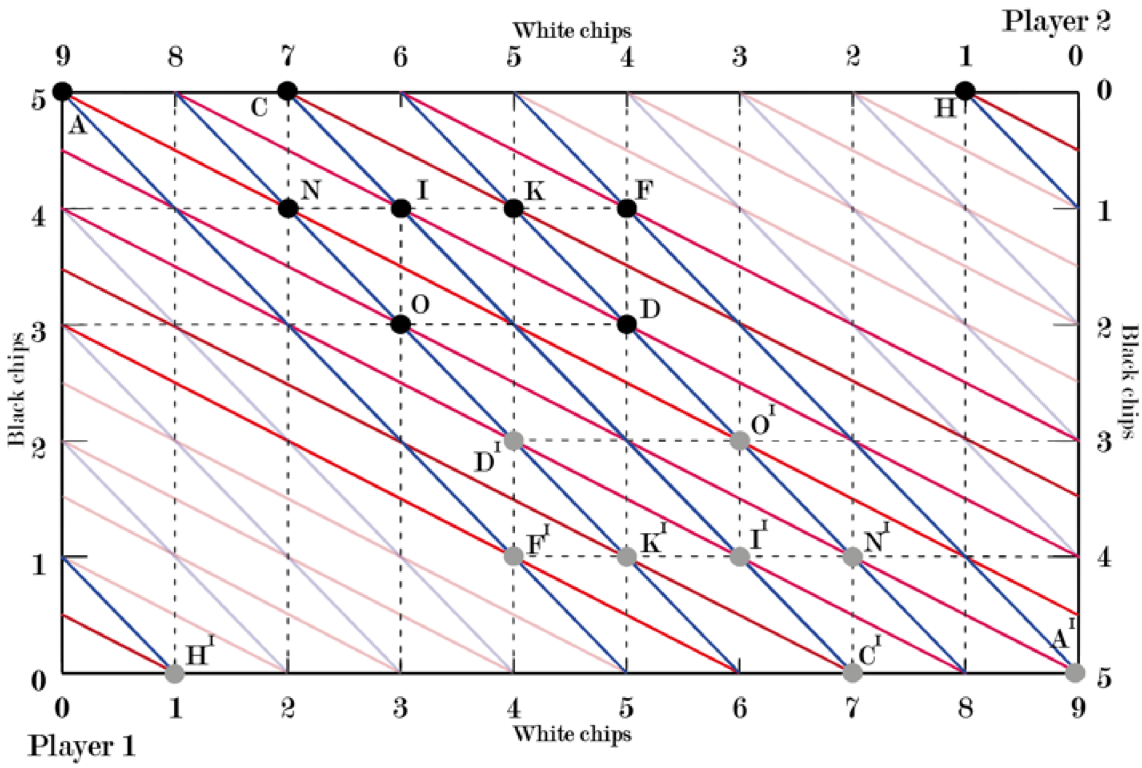


Figure 6: Complicated Games with low payoff - Indifference curves

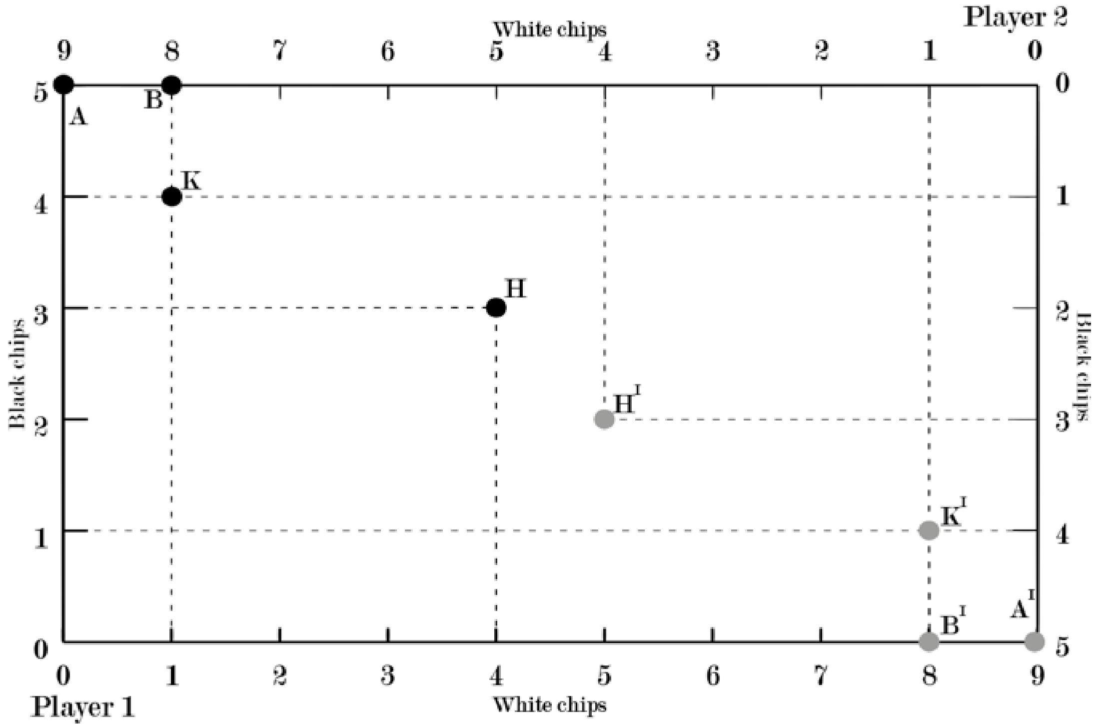


Figure 7: Complicated Games with high payoff - Players' choices

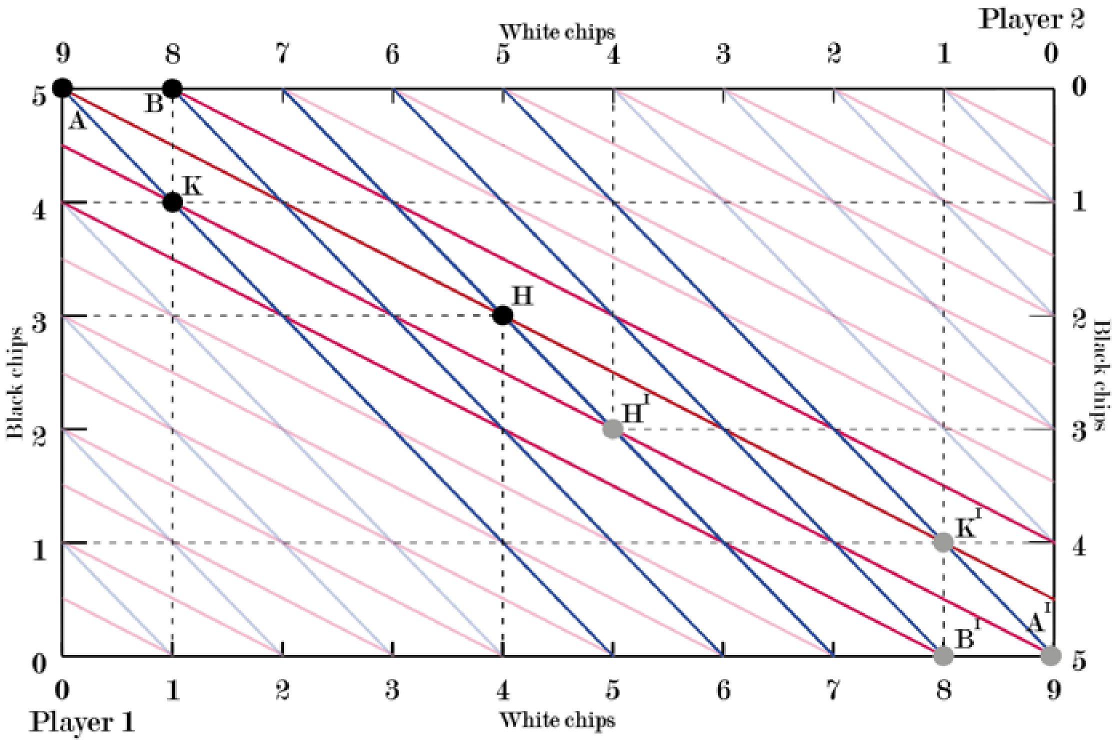


Figure 8: Complicated Games with high payoff - Indifference curves

2 Ultimatum Game: a Selective Survey of the Literature

UG is the simplest bargaining games from a structural point of view - it includes two players, two periods and complete information - but one of the behaviourally most complex. In fact, the motivations behind players' decisions are varied, they go beyond the simple maximization of utility that classical theory affirms and have attracted the attention of researchers who have long been working to understand them.

Experimental research on UG began in the late 1970s and early 1980s. The main source of interest was the study of negotiation and the limits of traditional theory of rationality and opportunism. (Güth and Kocher, 2014)

The UG results fundamentally challenge the narrow concept of material opportunism, as individuals reject positive offers, and therefore money, that would improve their position. Analysing these results, it is possible to affirm that they do not necessarily deviate from the concept of rationality in a broad sense, but rather take over motivations, emotions, preferences not studied so far.

In everyday life the actions taken by individuals are conditioned, they are not perfectly rational, and even subtle accidental moods can play an important role in the decision-making process. In the same way, it is impossible to think that, when faced with an experimentally designed choice, people can react one hundred percent freely and not behave in a way that is affected by the situation itself. If in real life there are feelings, moods and much more that can lead to cognitive bias and decisions taken in an illogical way, in the same way mechanisms take over in the laboratory that cannot achieve the highest-quality of research possible, and instead create distortions. Knowing or not the situation to be studied in the laboratory, the experimenters and opponents, reading instructions set in a certain way, negotiating a large or small amount of money of one's own or given by the researchers, can affect the results of the experiment.

The study of the UG has been several partially overlapping stages of development within the research community. At the beginning Werner Güth, dedicating part of his 1976 paper "Towards a more general study of v. Stackelberg-situations", describes UG as a purely theoretical idea to demonstrate that some assumptions of simple economic models are not adequate.

After experimentally implementing the UG studies and publishing the initial studies in 1982, Güth and the researchers dwell on understanding and explaining the behaviour of the participants in the game.

In turn, the data from the game inspires modern theoretical models of social preferences within a population.

In fact, several experiments have been conducted in different parts of the world with very strong cultural heterogeneity, to understand what the thresholds of equity are and whether they differ from population to population.For example, Henrich (2000) conducted an ultimatum bargaining between the Machiguenga tribes of the Peruvian Amazon, Bahry and Wilson (2006) developed an experiment in two multi-ethnic republics of Russia while Roth et al. (1991) showed difference between subjects in Israel and Japan compared to that of Slovenia and the U.S. (Van Damme, Binmore, Roth, Samuelson, Winter, Bolton, and Kocher, 2014)

At the end, the UG has become a multidisciplinary tool for the study of different themes and it has provided a bridge between economics and other social sciences, and has deeply influenced many economists, both theoretical and experimental. (Güth and Kocher, 2014)

Therefore, while for years the "homo oeconomicus" model has represented the approximation that best suited reality, currently there is an increasing tendency to support the social relevance of motivational guidelines, trying to achieve more plausible deductions.

2.1 Ultimatum Game: Anomaly or Rule?

After Güth et al.'s first ultimatum bargaining experiment in 1982, which showed rather complex data suitable for various considerations, economists, as well as psychologists, studied this game in an experimental and behavioral way, attracted by the result that people systematically deviate from the prediction of ultimatum bargaining based on maximizing utility. So, if one searches "Ultimatum Game" or "Ultimatum Bargaining" on Google Scholar, the total results are more than 100,000. (Güth and Kocher, 2014)

Covering the last forty years, this extensive publication of experiments and variations of ultimatum games have tried to bridge the discrepancies between experimental and theoretical results, modifying the structure of the experiment or specifically studying the behaviour of Proposer and Responder.

The experiments related to the theory have been expanded and modified as well as the fields of application of the theory, passing from a purely economic game to a sociological, psychological and communication one.

The UG can be considered among the so-called “anomalies”, i.e. everything that is not perfectly in line with the cause-effect logic that influences the strategies that an individual adopts every day. (Thaler 1988) In fact, in UG the players’ behavioural mechanisms are very different from the classic theory: rather than accepting an unfair distribution, individuals prefer to “boycott” an agreement that would also bring themselves a material advantage. Moreover, even for those who make the choice of division, there is the fear of being subsequently boycotted, and for this reason completely unfair proposals are rarely made.

Advocates of the opinion that equity-driven behaviour is not stable, i.e. “it can be easily displaced by simple optimazing behaviour” (Binmore et al.1985) and it is only an experimental exception, are Binmore, Shaked and Sutton (1985).

The experiment was born in response to the first experiment of Güth et al. (1982), to show that their conclusion is unjustified. (Binmore et al.1985) In fact, according to Binmore, predictive role of game theory has not been “unhinged”, but it is the structure of the experiment that gives those results. Binmore et al. (1985) themselves talk about “tension” between their theoretical approach, which follows Rubinstein model of bargaining, and the new approach of Güth et al. (1982), which underpins the concept of fairness.

Binmore et al.’s experiment (1985) experiment falls into that category of more complicated UGs -in particular, those with two stages and alternating roles - used to find conformity between analytical and empirical results. In particular, in Stage I the shrinking pie is equal to 100 pence, while in Stage II it is 25 pence. Thus, the discount factor δ is equal to 0.25.

In the first Stage, player 1 will ask for himself between 74-76 pence, and player 2 will accept any of his requests of 74 pence or less. In fact, if player 2 refuses, he could not achieve a better result, even if he gets the whole pie in the second stage. Hence, a game-theoretic solution of this experiment requires that the payoffs of players 1 and 2 are respectively 75 pence and 25 pence. (Binmore et al. 1985)

As in Güth et al. (1982), the experiment was performed several times. In the first game, the main tendency is to propose an equal subdivision (30 observations out of 82); in the second game,"a strong tendency to play like a game theorist" arises, i.e. players understood the game concept and acted as game theorist (Binmore et al. 1985). In particular, those who filled the role of player 2 in the first game and rejected a high demand, would not make a high demand as player 1 in the second stage but they did (50 observation out of 82 demanded 75 pence). (Binmore et al. 1985)

For these reasons, Binmore et al. (1985) describe two extreme positions: that of the "fairmen" who divide everything in equal parts, and that of the "gamesmen", who behave in a selfish and rational way as real economic agents. Hence, the fair division of the bargaining pie becomes "an obvious division and an acceptable compromise for an inexperienced player". Further, once a subject is fully aware of the structure of the game, considerations of strategic power should dominate. (Binmore et al. 1985)

However, Thaler (1988) states that Binmore et al. (1985)'s two extreme points of view do not describe what happens in real life. Individuals, in fact, prefer to improve their position, but not at the expense of others and vice versa, i.e. they want more money, as well as being treated and treating others fairly. When these two wills cannot coexist, they try to achieve a compromise.

Thus, one conclusion that emerges clearly from Thaler (1988), therefore, is that the results of negotiations are strongly influenced by the notions of fairness, which play a significant role but do not exclude the presence of other factors, such as, for example, the greed of proponent. Economists tend to think that the agents in their models are like the "homo oeconomicus", and that they care more about wealth than issues like equity and fairness. Basically, the UG denies these statements because there is a tendency for a perfectly equal split (50-50) of the sum between the players in most cases.

Moreover, several aspects of Binmore et al.'s experiments (1985) raise questions about how to interpret their results. First of all, the individuals who participated in the experiment were not informed ex ante about the second period of UG play, but only during the course of the experiment; secondly, the instructions given by the experimenters to the participants emphasize the specific request to maximize their choices; moreover, the equilibrium value of the game was very positive, making it difficult for the Responder to reject this sum.

These remarks lead to several considerations. First of all, playing the simplest possible UG or a two-stage game involves different attitudes on the part of players. In addition, the size of the pie can create distortions in the game or, as in this case, bring the choices closer to the equilibrium value, which is a distinctly positive value. Furthermore, as shown later, the instructions given to the participants can also considerably influence the players' choices, until they are completely overturned.

2.2 Experimental Evidence on Equity in Bargaining Games

The trend towards the concept of fairness is not easy to believe and that is why researchers have tried to study the game from several perspectives, so that fairness is not an exception.

2.2.1 Auctioning the Right to Play

Researcher wondered whether such fairness could be a consequence of the endogenous endowment given to players, and not the result of the intrinsic characteristics of individuals.

So, what if it is the "cake" given by the researcher that raised such strong concerns about equity?

It is also true that the amount of money the player is provided with cannot actually change his wealth, as it is fictitious. On the other hand, however, in everyday life one faces problems related to a value as small as that of experiments and it is precisely in a context like this that the concept of fairness can veritably be highlighted.

Güth and Tietz (1986) eliminate endogenous allocation of participation rights and use auctions to allocate the right to play in the UG. The reason why participation rights in auctions should be expected to influence the UG is that competing and winning in

Table 6: Güth and Tietz, Auction winners - 1st game

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
15.00	8.00	1	53.33
15.00	8.00	1	53.33
15.00	8.50	0	56.67
15.00	9.00	1	60.00
55.00	28.00	1	50.91
55.00	35.00	1	63.64
55.00	40.00	1	72.73
55.00	45.00	1	81.82
100.00	55.00	1	55.00
100.00	55.00	1	55.00
100.00	60.00	1	60.00
100.00	61.00	1	61.00

Source: Güth and Tietz (1986), table 1, page 420

Table 7: Güth and Tietz, Auction winners - 2nd game

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
15.00	10.00	1	66.67
15.00	10.00	1	66.67
15.00	10.50	1	66.67
15.00	11.00	0	73.33
55.00	30.00	1	54.55
55.00	35.00	1	63.64
55.00	37.00	1	67.27
55.00	50.00	0	90.91
100.00	60.00	1	60.00
100.00	65.00	1	65.00
100.00	67.00	1	67.00
100.00	70.00	1	70.00

Source: Güth and Tietz (1986), table 1, page 420

an auction creates a stronger sense of entitlement than simply awarding participation rights.

In fact, gaining the competitive advantage of splitting the amount, for example, means that the Proposer actually behaves as such in order to exploit that advantage, and likewise the Responder will not often implement a punishment mechanism against the individual who has earned that right.

Güth and Tietz's experiment is divided into three decision rounds, each of which has six randomly divided subgroups of players. In turn, each subgroup plays as Proposer or Responder in a UG with a "cake" of 15, 55 and 100 DM.

Each subgroup participates in a auction with the second highest bid price to de-

Table 8: Güth and Tietz, Auction winners - 3rd game

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
15.00	7.50	1	50.00
15.00	9.00	1	60.00
15.00	9.50	1	63.33
15.00	10.00	1	66.67
55.00	20.00	1	36.36
55.00	36.00	1	65.45
55.00	41.25	1	75.00
55.00	45.00	1	81.82
100.00	60.00	1	60.00
100.00	70.00	1	70.00
100.00	78.00	1	78.00
100.00	81.00	0	81.00

Source: Güth and Tietz (1986), table 1, page 420

termine the strategic positions in the game, i.e. the only members who will eventually play. Subsequently, the winners of the auction are privately informed of the price they have to pay for their strategic position, and they are properly matched to their opponent but do not know his price. Then, they proceed to play the ultimatum games. (Güth and Tietz 1986) The monetary reward of an auction winner is his monetary payoff in the UG minus the price of his position. For this reason, the cash payment can be negative, especially if the Responder does not accept the bidder's proposal. Therefore, it has been explained to participants that offering "real value" is always optimal in such auction. In other words, having a chance to lose real money, one has to offer in a real way, making "wise and thoughtful choices". Tables 6, 7 and 8 show the Auction winners of the experiment.

The results of Güth and Tietz (1986) challenge the backward induction and do not verify subgame perfect Nash equilibria of the game. In case of a two-round UG, which imposes a shrinking cake, the theory that a party should receive the smallest possible part of the initial "cake" is never implemented in the experiment and first-round bids are rejected even if it is impossible to gain that amount in subsequent rounds. Moreover, the sometimes extremely low acceptance rates of Responders indicate that player 2 is often quite willing to sacrifice part of the amount offered to him in order to punish player 1 for making the "unfair" offer.

2.2.2 Multi-Period Ultimatum Games and Behavioural Fallout

Another strong contribution to the analysis of UG was made by Neelin, Sonnenschein, and Spiegel (1987).

Their experiment, similar to Güth and Tiezt's one, was done in response to the results of Binmore et al. (1985), to support the concept of fairness that emerged from the experiment of 1982. The subjects in Neelin et al.'s experiment (1987) played a series of multi-period ultimatum games, respectively two-period, three-period and five-period bargaining, for the distribution of an amount equal to 5 dollars. The discount factors used are the same for player 1 and player 2, but differ depending on the game.

According to Neelin et al. (1987), the different structure of the three games aims at avoiding the conclusion that fairness is related to a specific and particular game, without being able to be generalized.

The results of these three cases led to different conclusions. The two-period game had similar results to Binmore et al. (1985). Of the 50 "sellers" - so called, the Proposers or allocator, from Neelin et al.(1987) - 33 made an offer very close to the equilibrium value: in particular, the offers made are between \$1.25 and \$1.50 and the equilibrium value is \$1.26.

Nevertheless, in the case of three-period game, the results were completely different: in particular, 28 players out of 50 opposed a fair division of \$2.50, while 9 other players proposed \$0.50, when again the equilibrium value is \$1.26.

Even in the third game, the five-round game, the results have once again been different from the previous ones.

33 of the 50 offers are in the \$0.50-2.00 range. Players have adopted the strategy of offering the stakes for the second round, which turns out to be the equilibrium offer in the two-stage game, but not in the longer games. This is probably because the players do not evaluate the multi-round game in an aggregate manner, i.e. they behave as "myopic players". According to the behavioural theory by Shlomo Benartzi and Richard Thaler, many individuals suffer from what is known as "myopic loss aversion", which is an attitude of neglecting long-term perspectives to focus on short-term ones, which may be dominated by fear of loss.

Other players are defined as "conservatives", i.e. they tend to minimize the risk of their partner rejecting their offer for rational and irrational reasons. (Thaler 1988)

Since the length of UG is a feature that highlights several behavioural aspects, Neelin et. al (1987) have conducted a second experiment, in which subjects played the five-round game four times, with all payoffs increased by a factor of 3, i.e. with $c = \$15$. The results remained substantially unchanged as seventy percent of the offers are in the range of \$5.00-5.10 and the second round payoff is \$5.10. Moreover, no offers close to the equilibrium value have been observed, nor have individuals "learned" how to play this game over time, as Binmore et al. (1985) claimed. (Ochs and Roth, 1989) Thus, unlike the experiment of Binmore et al. (1985), in Neelin et al. (1987)'s research there is no inconsistency on the part of players, who act as "fairmen" in one role and as "gamesmen" in another.

The distinction between attitude for fairness and "gambling" has not been studied only by Binmore et al. (1985), who are the initiators, and by Neelin et al. (1987), with the multi-period games. The most articulated experiment of this kind in the history of experiments conducted so far is reported in Ochs and Roth (1988), which turns out to be unique in some differences from the previous ones.

The first difference is given by the multiplicity of times that players played the game before the experiment: 10 times. The aim of training is to understand if a mechanism of "familiarity" and "learning" is established in the minds of individuals, that makes them act as real economists.

During the 10 games, all the parameters of the game are kept constant, but the experiment has a stranger-matching design.

Each player instead has a different discount factor, obtained by bargaining between the subjects an amount equal to 100 chips.

The value of each chip is \$0.30 for each player, so the entire amount is $c = 30$.

In the second round the chips would be worth δ_1(\$0.30) for player 1 and δ_2(\$0.30) for player 2. In the third round, the discount rates are squared. Four combinations for (δ_1, δ_2) are experimentally varied: (.4, .4), (.6, .4), (.6, .6), e (.4, .6). These four conditions are crossed with the number of periods to be played (2 or 3) to produce a 4 $\times$ 2 experimental design. The data of Ochs and Roth (1989) are reported in Tables 9, 10 and 11 by aggregating the first three games, games 4 to 6, and games 7 to 10.

Table 9: Ochs and Roth, second round subgames - Games 1-3

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
12.00	6.00	1	50.00
12.00	10.80	0	90.00
12.00	11.88	0	99.00
18.00	9.00	1	50.00
18.00	9.36	1	52.00
18.00	9.90	1	55.00
18.00	9.90	1	55.00
18.00	13.50	1	75.00
18.00	14.40	0	80.00

Source: Güth and Tietz (1986), table 1, page 421

Table 10: Ochs and Roth, second round subgames - Games 4-6

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
12.00	6.00	1	50.00
12.00	9.60	0	80.00
12.00	11.88	0	99.00
18.00	9.54	1	53.00
18.00	9.90	1	55.00
18.00	10.80	1	60.00
18.00	13.50	0	75.00

Source: Güth and Tietz (1986), table 1, page 421

Table 11: Ochs and Roth, second round subgames - Games 7-10

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
12.00	7.80	1	65.00
12.00	8.40	0	70.00
12.00	8.40	0	70.00
12.00	10.00	0	83.33
18.00	9.00	1	50.00
18.00	9.90	0	55.00
18.00	9.90	0	55.00
18.00	10.80	0	60.00
18.00	13.50	0	75.00

Source: Güth and Tietz (1986), table 1, page 421

Ochs and Roth (1988) have decided to implement such a complicated and ambitious experiment to verify some implications of bargaining theory. In particular, in case of three-period bargaining game, the most relevant discount factor should be that of player 1. The latter is the one who makes the first as well as the last offer in odd periods: therefore, holding the discount rates constant, he should make player 2 earn less. (Ochs and Roth, 1989)

The results of these experiments prove that the subgame perfect nash equilibria of game theory lose the predictive role given to it. In fact, they provide poor support for the descriptive value that game theory has had so far: a change in player l's discount factor should have no influence on the proposals made in two-period game but it is not demonstrated; moreover, holding discount factors constant, the proposal made to player 2 in the three-period game is not less than the proposal made in the two-period game. Thus, the discount rate of player 1 is relevant when it should not and the game's length does not count when it should.

Furthermore, Ochs and Roth (1988) also supported Güth et al.'s (1982) argument that Responders are willing to reject positive but unfair offers.

Tables 12, 13 and 14 are the corresponding data of the third round subgames of Ochs and Roth (1989). It is only included results of last-round subgames with equal discount factors for both players.

Table 12: Ochs and Roth, Third round subgames - Games 1-3

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
5.00	4.00	0	80.00
11.00	5.50	0	50.00

Source: Güth and Tietz (1986), table 1, page 421

The results illustrated so far have corroborated the theory of first experiments on UG: in the real world the choices made by the two players are not only guided by the rationality that game theory enunciates, but are the result of a trade-off between rational strategy and the general sense of fairness that characterizes all human beings.

The Responder, in fact, is the one who, for reasons of fairness, rejects offers considered disrespectful. This rejection is favoured by the fact that, if the offer made by the Proposer were particularly unbalanced, the amount refused by him would be derisory

Table 13: Ochs and Roth, Third round subgames - Games 4-6

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
11.00	5.50	1	50.00
11.00	6.49	0	59.00
11.00	9.35	0	85.00

Source: Güth and Tietz (1986), table 1, page 421

compared to the damage he could cause the other party by his refusal.

Table 14: Ochs and Roth, Third round subgames - Games 7-10

c (DM)	d_1 (DM)	$\delta_2(d_1)$	d_1/c (%)
5.00	2.50	1	50.00
11.00	5.50	1	50.00
11.00	6.60	1	60.00

Source: Güth and Tietz (1986), table 1, page 421

In the same way, such a trade-off also influences the Proposer who avoids proposing divisions which could give rise to disagreement with the Responder, to keep away a possible punishment and achieve the desired cooperation.

But who is most influenced by the so-called sense of fairness? The two players are not influenced in the same way: the Proposer is inclined to act correctly towards the Responder, but this is not exclusively due to his respect for the other party or his moral integrity, but rather to his fear of retaliation by the Responder, who may decide to sacrifice his gain, in order to punish the opponent's behaviour, judged unfair and therefore offensive.

2.3 Ultimatum and Dictator Games: Property Rights and Other Regarding Preferences

What if the Responder does not have the right to accept or reject the offer? Does equity also exist when the risk of rejection is eliminated?

Kanheman, Knetsch and Thaler (1986) conducted two experiments: one that replicated the UG of Güth et al. (1982) and one called Dictator Game (DG).

The DG is designed to assess how individuals respond to situations in which self-interest and equity are opposed. In this case, the Proposer will have upper hand and will no longer have reason to fear punishment from the Responder. The latter can only passively accept what is given to him and has no "weapon" at his disposal to strike the Proposer if the size of the "pie" does not satisfy him. In such cases, the Proposer will be free to leave his opponent as small as possible or to keep the whole amount for himself, and every time he decides to give something more to the competitor, one will be sure that he has done it only because he believes in the principle of fairness and wants to respect it, and not for fear of "revenge". Therefore, it is stated that DG has 1 decision point for player 1 and no decision point for player 2.

In particular, Kanheman, Knetsch and Thaler (1986) investigated this issue. In the first part of the experiment, they asked students at Cornell University to split $20 between them and another anonymous member of the class. In particular, those who are charged with the choice of splitting are given only two choices: they could keep $18 for themselves and give their partner $2, or they could offer a share of $10 each. Not all students are paid, but only eight randomly chosen pairs. The peculiarity of this experiment, unlike previous experiments, is that the Proposers' offers cannot be rejected by the Responders. Nevertheless, the offers have been very generous. Of the 161 subjects, 122 (76%) have decided to divide 20 dollars equally. Therefore, part of the explanation for the generous offers observed seems to be explained by a sense of fairness on the part of the Proposers.

After completing the first experiment, the students themselves are asked to do a second one. In the latter, two players are chosen from those who have not been paid in the first experiment. One of them has previously chosen to divide the sum into (18, 2), keeping $18 for himself, and the other has chosen to divide it equally into (10, 10). A third player is called upon to choose whether: keep $6 for himself and give $6 to the one who was greedy in the previous experiment (the one who took $18) or keep $5 for himself and give $5 to the player who was generous in the previous experiment. This has been done to see if the punishment mechanism can be implemented by a third party. This one, knowing "the reputation" of the two players through the previous experiment, can decide to give up $1 to share the amount with the generous player. Most of the students - about 74% - in this experiment made the decision to share a smaller amount with the one who was generous in the previous game.

In conclusion, it is possible to state that equity exists also when the risk of rejection is eliminated, as one can see in DG. Even in this case, positive offers are made by the Proposer, leading to the conclusion that who allocates the amount is guided by a sense of equity, supporting the theoretical position underlying the conceptualizations of equity theory (Gouldner 1960, Adams 1965).

Forsythe et al. (1994) also studied the case of Ultimatum and Dictator games. He decided to make two types of payment for each type of experiment. The design is 2x2 with UG and DG and “pay” and “not pay” model. The basic model, therefore, is a simple UG/DG with a given amount in endowment, in which individuals are paid for participation in the experiment. Instead, in the “advanced type” they also receive what comes from the split in the UG/DG, i.e. they earn \$3 for participation plus the payoffs of the game.

Their results of UG/DG endorse the theory of fairness of Kahneman, Knetsch, and Thaler (1986):only about 20% of dictator Proposers offer \$0 to their Responder counterparts. Nonetheless, they conclude that fairness cannot be the only explanation for the positive offers observed, since the outcomes of ultimatum and dictator games with payments are significantly different.

Hoffman et al. (1994) recognized that another important factors can be reputation: “maintaining reputation might create expectation that change Proposers’ behaviour”. (Hoffman et al. 1994) In Kahneman, Knetsch, and Thaler (1986) and Forsythe et al. (1994), players do not behave as expected by the theoretical economic/game theory. In particular, proponents offer half of the endowed amount and Responders are not willing to accept less than half of the pie. Hoffman et al. (1994) try not only to replicate the simple UG of Forsythe et al. (1994), but also to explore three variations in a 2x2 experimental design. These changes are due to the design of Kahneman, Knetsch, and Thaler (1986) and Forsythe et al. (1994), which could invoke the equality norm: “provisionally allocated” amount which is expected to be divided by the Proposer might cause a behavioural deviation.

A completely different perspective is therefore used. In Hoffman et al. (1994), the effect of inducing a property right in the Proposer position is considered. In bargaining games, such as the ultimatum game, the Proposer with a legitimate property right may be more inclined to pursue his strategic advantage. Likewise, the right acquired by the Proposer may diminish the possible punishment of the respondent, who sees the former as legitimated to exploit his position. Therefore, playing a property right auction game could demonstrate or drop the conclusions regarding the equity norm. (Hoffman, McCabe, and Smith, 2008)

Following Fouraker and Siegel (1963) who generate subgame perfect equilibrium results using a seller–buyer exchange, Hoffman et al. (1994)'s first variation, called the "exchange treatment", is set in a market environment, in which the "sellers" - Proposers - choose the "price" and the "buyers" - Responders - indicates whether they are willing to "buy or not buy". In particular, the seller chooses a price from \$0 and \$10.

The structure of the game with sellers and buyers instead of Proposers and recipients, is based on American culture and liberalism, according to which sellers have the "right" to make a profit by moving first of all to quote a price.

Hence, if the seller chooses a price equal to \$0, it will imply a profit equal to \$0 for the seller himself and \$10 for the buyer, in case of buyer's acceptance. Regardless of the price chosen by the seller, the buyer's choice of "not buying" implies zero profit for both players, just like in UG.

The second follows Hoffman and Spitzer (1963), is the so called "contest treatment". The peculiarity of this game is that Proposers have to "earn the property right" to be in that specific position, getting a high score in a general knowledge quiz.

The third treatment is a perfect combination between the two treatments above. "Sellers in a market are justified in earning a profit and individuals who have earned the right to a higher return are justified in collecting it."

Hoffman et al. (1994) describes the experiments Kahneman, Knetsch, and Thaler (1986) and Forsythe et al. (1994) as "random/divide" and compare it with a "context/exchange" treatment combining the two methods of induction of the Proposer's property rights.

From the Proposer's point of view, depending on the way the right is assigned and the context described in the instructions, the results show different trends. In case "contest/divide" treatment and "random/divide" treatment are compared, where the right to be Proposer is given by the general knowledge questionnaire, higher offers are observed in the “random/divide” treatment. The latter, compared to the “random/exchange”, always shows higher offers than the other. If one compares the “random/exchange” with the “contest/exchange”, the latter shows smaller offers. If one compares the “contest/divide” and the “contest/exchange”, the latter causes a reduction in offers. Finally, from “random/divide” to “contest/treatment” there is a significant shift towards smaller offers. (Hoffman, McCabe, and Smith, 2008)

From the Responder’s point of view, it can be said that in all cases there are very low rejection rates, even zero in the “contest/divide”. Thus, there is not only a change in the Proposer’s behaviour, but also in the respondent’s expectations of the Proposer’s behaviour. (Hoffman, McCabe, and Smith, 2008)

Hoffman, McCabe, and Smith (1994) try also to extend the three experiments to cases with larger amounts to be divided. In particular, considering an amount equal to \$100: in the first two experiments, Proposers often offer \$50 and offers lower than \$50 are rejected; in the third one - “contest/exchange” experiment- Proposers typically offer \$30, and offers equal to \$10 are often rejected. (Hoffman, McCabe, and Smith, 2008) Comparing experiments with a total amount equal to \$10 and that with \$100, the results are completely unchanged: no significant differences emerge in the Proposer/seller’s offers as a result of the change in monetary stakes.

In the case of DGs, Proposer dictators offer less to their opponents than they do in UGs; few players offer \$0 and in the “contest/exchange” treatment results still tend to “self-regarding” offers.

The results of these experiments clearly show how strong the impact of property rights on the shared expectations - both that of Proposer and Responder - about the appropriate behaviour of Proposers in both ultimatum and dictator games is.

The random assignment made in the first ultimatum experiments did not guarantee legitimacy to the Proposer who, for this reason, could not exploit his competitive advantage. Doing this means creating a strong tendency for the Responder to reject offers, even though this rejection had a cost. For this reason, the rule of equity applies and both players assume that it is the right behaviour in these cases. Thus, in the ultimatum game, the Proposer knows that deviations from the equal division can be punished.

However, when the experiment is set to market logic and context, with the seller replacing the Proposer, the seller is allowed to earn a "profit" on the exchange, just as in a real context. Similarly, when the proponent earns the right to be so through a questionnaire, the rule of fairness legitimises him to offer less than half.

As for the game in the dictator, almost 50% of the selling dictators, who have earned the right to be sellers, give $0 to their counterparts, as predicted by the subgame perfect equilibrium of game theory.

Hoffman et al. (1994) also used treatments that emphasise how UG and DGs have an interactive aspect in the instructions for Proposers. (Güth and Kocher, 2014). They have tested how the instructions in UG of the experiment itself influence players' decisions. Indeed, there is also a correlation between the way the instructions are formulated and the decisions made by the players. For example, they noted that by saying "...consider what choice you expect the buyer to make," or "...consider what you think the buyer expects you to choose", the players reversed their decisions. In fact, the second sentence "invites" Proposers to "pay special attention" to the future decision of Responders, i.e. to consider the opponents' strategic possibility of rejection. Nonetheless, positive offers made in DGs cannot be explained in the same way. Since for example in Forsythe et al. (1994) subjects are not anonymous to the experimenters, the hypothesis is that positive offers in DG are made with a view to reputation, thus players want to safeguard their image with regard to researchers. (Hoffman, McCabe, and Smith, 2008)

Consequently, Hoffman et al. (1994) design a specific experiment about DG in order to investigate the role of social isolation.

For this reason, they have implemented a "double-blind procedure" in the games, in which players are completely anonymous - they are not known by experimenters and opponents - in order to understand their level of altruism. In fact, pre-play communication - the possibility of communicating before the game starts- or, even more, of getting to know each other in depth, can lead to equality effects on the players. Instead, the greater perceived interpersonal distance by the agents, the further away is fairness.

The results are completely different from the ones of Forsythe et al. (1994): Proposers take a larger amount for themselves, which is very close to the total amount itself. Hence, as social distance between players and experimenters increases, offers to Responders decrease. So, equity and reciprocity are also enforced by the power of isolation. (Hoffman, McCabe, and Smith, 2008)

2.4 The Dynamics of Responder Behaviour

So far, the question that researchers put at the basis of their experiments is: "Why do respondents reject positive offers?" and they have tried to show how there is a deep influence of "social preferences" on decision making, and how ethics and the concept of fairness strongly affect acceptance or rejection by the Responder. Now, Cooper et al. (2011) dwell instead on how the Responder's behaviour changes with experience and how this can lead to fairness. In particular, they understood that repeated games can create a learning mechanism in participants because "percistency is an important element of robustness". Whether the players' behaviour in the UG converges toward rational play or fair play in repeated ultimatum games depends on the experience the players have had. Cooper et al. (2011) explain their idea through a scenario with a fixed group of responders and a variable group of experienced and inexperienced Proposers. If experienced Proposers learn that low offers are rejected and adapt their offers accordingly, the game would converge towards equity. If, on the other hand, the Proposers are inexperienced, a large number of low offers would occur and the game would converge towards unequal distribution. Previous studies had found evidence of the change in Responder behaviour over time, but not formally and not strictly related to the distribution of offers. What Cooper et al.(2011) try to prove is that the acceptance rate is a function of the offer and to explore the adjustment process that leads to changes in respondents' choices. To do this, they start from previous experiments and divide them into 3 macro-categories, different for nature of other-regarding behaviour and for predictions on how the Responder's behaviour changes with experience. In this way, not only do they facilitate the study of an extensive literature on the subject, but they increase the power of the dataset itself, consisting of 7,188 observations from 387 subjects in 44 sessions, enough to detect slight changes in Responder behaviour.

The first category is "*Distribution Preferences*": in the models that fall in this section, the Responders reject positive offers because the disutility of receiving a lower payoff than that of the Proposer is greater than the utility of receiving a positive payoff. Therefore, the preferences of the individuals of this model are stable and in function of the own profit and that of the Proposer. They, therefore, do not foresee changes in the behavior of the respondents over time.

The second category is that of the "*Preferences with Reciprocity*", whose models that formalize it follow the hypothesis that the rejections by the Responder, who are not only worried about the offer they receive but also about the process that led to the offer, reflect an attempt to punish "unkind" actions. What the models in this section have in common is the utility function of the Responder, which includes both a variety of static distribution preferences that do not vary with experience, and a variable that changes with changing beliefs. For this reason, offers that previously seemed ungenerous may later appear to be generous, and offers that previously seemed kind may no longer be accepted. Overly optimistic individuals will learn to expect and accept lower offers and vice versa. Therefore, these models provide rising acceptance rates for high offers and falling acceptance rates for low offers.

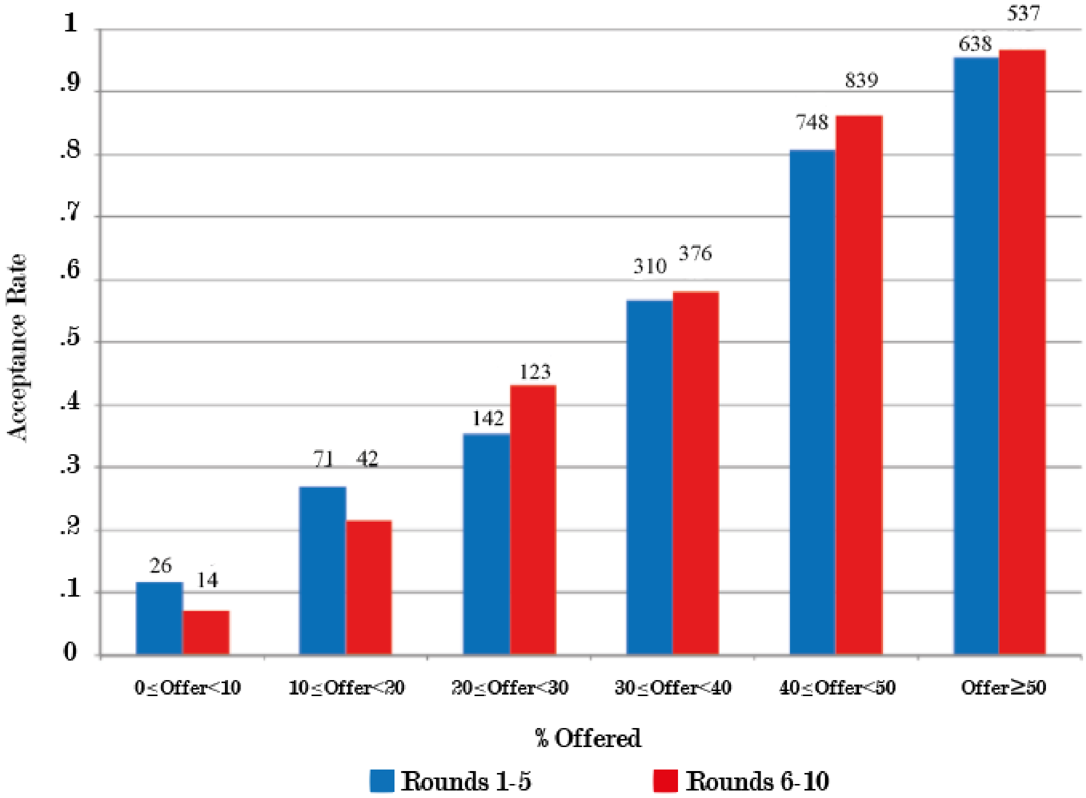
The third and final category is the "*Reinforcement Learning*". This category is based on standard preferences, i.e. it is based exclusively in terms of monetary profit. After a strategy has been selected and played randomly, the probability that it will be used in the next period increases proportionally to the profit realized with that same strategy. Therefore, strategies that achieve higher gains tend to be played more frequently over time. Unlike previous preference models, it is expected that acceptance rates will increase for all offers because, of course, acceptance always leads to a higher profit than rejection of an offer.

All data collected from the three categories came from standard, anonymous UGs with at least 10 rounds of play. Players kept their role for the whole duration of the experiment but with either stranger or absolute stranger matching pattern.

The main result of Cooper et al. (2011) meta-analysis is that acceptance rates change over time. Figure 9 can provide a simple explanation of this analysis.

In the last rounds, the acceptance rate is higher than in the first rounds. The offers

Figure 9: Acceptance rate as a function of experience



Source: Cooper et al. (2011), pages 529

have been divided by tenths of the pie, on the x-axis, while the acceptance rate is on the y-axis. The blue bars represent the offers made in rounds 1 to 5 and the red bars in rounds 6 to 10. The figure shows a clear pattern of how acceptance rates change over time: for the two lowest offer categories, acceptance rates are lower for rounds 6-10 than for rounds 1-5. For all remaining categories, acceptance rates are higher in rounds 6-10.

The results therefore show that respondents' behaviour changes with experience: high offers are more likely to be accepted and low offers are less likely to be accepted. Both players know that if the Responder refuses, both will take nothing. In the experience of both, when an offer is considered high and acceptable, the offer will be accepted, and for this same experience, later offers will be rejected. In the same way, when an offer is considered low and unacceptable, the offer will be rejected, and for this same experience, later offers will be accepted.

2.5 Intercultural Differences in Responder Decisions

In the literature, it has also been investigated whether subjects' behaviours in UG is systematically related to the countries where the subjects themselves live and from which they have developed their culture and learned social norms. Experiments were conducted, therefore, that involved populations from all over the world, both in large cities of different countries and populations living in small non-industrialized communities. All this in order to question the idea that people share the same values and, consequently, the decision-making processes.

Henrich (2000) reports the results of an experiment conducted with an indigenous population of Peru, the Machiguenga, which actually confirmed this hypothesis. A comparison experiment was then carried out in the same way in Los Angeles, with graduate students. The amount offered is very different in the two cases, while the difference in the percentage of rejection is quite limited. Through interviews carried out after the experiment, the Machiguenga explained their motivations. In particular, the Responder rather than attributing a "bad" attitude to the Proposer, seemed inclined to attribute to bad luck the fact of having that role instead of being the Proposer, then accepting the consequences without any kind of revenge against the other party. The few Peruvian Proposers who offered 50%, claimed to have done so because that was a fair stake - so for their own considerations of fairness and not for fear that the offer would be rejected. On the other hand, the Los Angeles Responders stated that they would reject any unfair offer, which for some is around 25%, for others 50% of the sum itself. The Proposers, on the other hand, followed the logic of "I have to give him enough so that he does not refuse".

The Machiguenga-Los Angeles comparison suggests that cultural differences can have a significant influence on each other's behaviour, but it does so by comparing two very distant cultural systems. Roth et al. (1991) and others have conducted experiments in different geographical and cultural areas in order to explore the topic further, making it possible to compare data on Ultimatum Game played in the most diverse contexts.

Oosterbeck et al. (2001) have collected in a single article the results of 32 experiments conducted in different areas of the world. They found no significant differences in the Proposers' behaviour between regions. The behavior of the Responder, however, is different: those in Asia have significantly higher rejection rates than those in the United States and those in the western part of the United States have lower rejection rates than those in the eastern part of the United States.

The authors, then, group countries according to other cultural characteristics such as religions, individualism, traditionalism, respect for authority, physical and economic security and so on. Statistical tests, in these cases, deny the existence of significant differences in behaviour in different cultural contexts, as on the other hand the simple observation of the data suggests.

Consequently, cultural differences count, in the sense that the environment in which one lives counts. The fact that there are differences in geographical areas, but there are no peculiarities of behaviour with regard to ideological aspects, suggests that it is the interactions between subjects living in the same social and economic environment that give rise to different expectations about the behaviour of others. Therefore, it is possible to say that there are geographical differences but not what is the origin of reciprocity.

3 The Experiment

The data used in the experiment have been kindly granted to me by Prof.ssa Di Cagno and the other researchers who have dealt with this experiment. The results of the research in which these data are involved are currently being published (see Buso et al. (2020)). In the following chapter will be described the experimental setting and its main characteristics. The originality and innovation of this study lie in the experimental methodology. Everything stems from the need to cope with the forced impossibility to carry out live experiments due to Coronavirus epidemic's outbreak in China between the end of 2019 and the beginning of 2020. What appeared to be a localized epidemic, however, turned out to be a global pandemic in the following months. The spread of Covid-19 affected the whole world and at the end of February 2020 Italy became the second country with the highest number of cases. Thus, on March 9, 2020 was issued the Prime Minister's Decree that brings new measures to contain and contrast the spread of the virus throughout Italy and which led to the suspension of several production activities, universities and even quarantine.

This situation has strongly impacted on everyday life. Due to the legislative dispositions, the online has been given space, also from an experimental and scientific point of view.

This experiment is a result of this new perspective. It took place at CESARE ON LINE, the virtual Centre for Experimental Economics of LUISS Guido Carli in Rome.

Before performing the experiment on the Ultimatum Game, several attempts were made to make the experiment as close as possible to the existing physical laboratory mode and to refine its methodology. During the test of the experiment, some student volunteers were called to evaluate the functionality of the platforms and their availability, to ensure transparency, anonymity, and a proper monitoring of experimental subjects, "de facto" replicating a physical laboratory environment.

Each participant followed several steps: they all registered to Prolific platform[1], thanks to which they were provided with their own ID and compensated at the end of the experiment; they had to be equipped with their own webcam device to allow

[1] https://www.prolific.co/

monitoring through WebEx[2] and Veconlab[3] - the platforms used to create virtual cubicles and monitor the participants and to carry out the experiment and collect the participants' data respectively - by experimenters, and to maintain a video and audio contact for the entire duration of the session, otherwise they would be excluded from the experiment.

There were 3 sessions, respectively on April 21st, 22nd and 24th. These three sessions were attended by 54 participants, all undergraduate and graduate students of Luiss Guido Carli. In summary, the methodological innovation of the study is to conduct a scientific experiment as close as possible to that performed in a physical laboratory but online.

Individual payment was made conditional upon the participant filling out of a mandatory survey including demographic questions needed for the research. Each subject received a participation fee equal to 6 euros, plus the actual gain during the experiment. The payoffs of each round were expressed in dollars, but the final payment for each participant was converted into euros with a conversion rate equal to 150%, i.e. 1 dollar = 1.5 euros. The actual payment of the experiment was equal to 10% of the accumulated earning in the experiment.

The experiment consists of two Phases. At the beginning of the experiment, each participant is automatically assigned the roles of Proposer or Responder, which will be maintained for both Phases. The pairs of participants are formed once in Phase 1 and then formed again by the computer in Phase 2 and will remain the same.

Phase 1 has a DG design consisting of only one round. The computer assigns randomly and anonymously participants to the role of Proposer or Responder. As in DG, the decision made by the Proposer determines the payoffs, and therefore the earnings, of both players. The Responder, however, does not have to make any decisions at this stage. The amount that the Proposer has to divide between himself and the Responder is equal to $10. In particular, he will have to choose the part to keep for himself, determining the amount for the Responder accordingly.

Phase 2 is composed of 9 rounds and it has the structure of a UG. Although the

[2]https://www.webex.com/it/index.html

[3]http://veconlab.econ.virginia.edu/

roles are the same - who was Proposer/Responder in Phase 1, has the same role in Phase 2 - pairs are different and chosen randomly and anonymously by the computer, as previously mentioned. At the beginning of each round, the Proposer has to choose how to divide $10 between the Responder and himself. In particular, he is asked to choose which part of the endowed amount he wants to keep for himself.

In both Phase 1 and Phase 2, the Proposer can only choose integer values between $0 and $10, extremes included.

In Phase 2, the Responder, having known the split, decides whether to accept or reject the offer. In the first case, the split takes place and each participant earns for that round the amount that the Proposer has previously determined. In the second case, both members of the pair earn $0.

At the end of each round, each player will know the other's choice and their relative payoff. At the end of Phase 2, Proposer and Responder will receive a survey via e-mail necessary to make the payment available. Consequently, the 10% of the cumulative gain realized during the whole experiment will be shown in the participants' Prolific account within a few hours after the end of the experiment.

4 Data Analysis

4.1 Descriptive Statistics and Preliminary Evidence

The analysis of the dataset are conducted using STATA. It begins with the study of descriptive statistics, which are used to inspect the data.

The analysis of the data will be focused on the Ultimatum Game: in particular, I will analyse the Responders' behaviour and how it is affected by different factors such as Proposer Demand in current and prior period, Acceptance in prior period, region, macro-region, gender, age and degree.

There are 243 observations available out of 270, which are equivalent to 9 rounds of game for 27 players. In fact, the first round of the game - which count 27 observations in total - will not be studied for each participant because it pertains to the Dictator game.

Table 15: Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max
Game				
Proposer Demand in t	5.765	.999	3	10
Acceptance in t	.852	.356	0	1
Demographics				
Age	23.593	2.915	19	30
English level	3.704	.458	3	4
First UG Round				
Accept in t=1	.778	.417	0	1

4.1.1 Demographics

First of all, it is important to understand the main characteristics of the sample. The analysis includes demographic variables collected with the final survey, which allows to control the effect that some individual characteristics may have on the probability of observing acceptance or rejection.

Specifically, the survey contained demographic questions to collect information on the background of players, which allow experimenters to know more deeply the target audience and to segment them according to who they are, where they live, their gender, knowledge of English, age and whether the participant is pursuing a degree in economics. The *Demographics* category in Table 15 shows the data collected for Age and English level. The average age of the sample is around 23 years, with a minimum of 19 and a maximum of 30. However, about 70% respondents declare they have an advanced level in English, while the remaining 30% have an intermediate level.

As far as gender of the participants is concerned, more than half of the sample is male, with a total of 15 males out of 27, which is the 55% of the sample. From a geographical point of view, the subjects who participated in the experiment were divided into 3 macro geographical areas: 51.85% comes from central Italy, followed by the 40.74% from southern Italy and islands, and the remaining 7.41% from northern Italy.

Through an analysis by subject and calculating the average acceptance rate for each subject, it is possible to compare the acceptance rate to the gender and the geographical origin of the participants. It is possible to state that women have on average an acceptance rate of 84.26%; men have a slightly higher acceptance rate of 85.93%. Instead, if one wants to compare acceptance to the geographical background of the players, the acceptance rate for those coming from central Italy is equal to 88.89%, followed by 84.85% for those from southern Italy and 61% for those from the north.

The sample's educational qualification was also analysed, to understand how many people could have been involved in the economic field. The dichotomous variable "Degree in economics" shows that about half of the participants has a degree in economics.

4.1.2 Proposer Demand in Current and Previous Period

The main object of the analysis is to study how the Proposer demand affects the Responder's behaviour. In the following section, I will try to find preliminary evidence of the Proposer demand on the current and past periods and the Responder's decision. These effects will be analysed later in section 4.2 by performing a regression. The *Game* category in Table 15 includes the variables Proposer Demand and Acceptance by the Responder in current period. It is possible to observe that the average demand, considering all the games in the dataset, is equal to 5.765, and it presents a maximum of 10 and a minimum of 3 euros.

The acceptance rate, instead, is a dichotomous variable, i.e. 1 corresponds to acceptance and 0 to rejection, and its mean is 0.852: approximately, 8 out of 10 proposals were accepted over the course of the experiment.

The total number of acceptance and rejection by the Responder in relation to Proposers' demands has been identified. Table 16 shows that 36 out of 243 observations represent the Responders' rejection of an average offer of 3,28 euros.

Table 16: Acceptances and rejections

Variable	Obs	Mean	Std. Dev.	Min	Max	Result
Proposer Demand	36	6.7222	1.0586	5	10	Rejected
	207	5.5991	.8915	3	9	Accepted

Specifically, the portion of the pie requested by Proposers for themselves in these 36 rejected rounds follows a minimum of 5 euros and a maximum of 10 euros. Therefore, the rejected offers are between 0 and 5 euros, presumably because of their unfair nature.

On the other side, 207 out of 243 observations are related to the acceptance by the

Responder to an average offer of 4.40 euros. In particular, the minimum offer is equal to 1, the maximum to 7.

Going deep into the analysis of the Proposer demand, it is possible to divide the above observations by demand levels, in order to effectively understand which offers have been made more frequently and which is the acceptance rate of that particular offer.

Table 17: Proposer Demands and Responses in detail

Proposer Demand	Rejection	Acceptance	Total	Acceptance Ratio	Relative Frequency	Cumulative Frequency
0	0	0	0	N/A	0.00%	0.00%
1	0	0	0	N/A	0.00%	0.00%
2	0	0	0	N/A	0.00%	0.00%
3	0	1	1	100.00%	0.41%	0.41%
4	0	6	6	100.00%	2.47%	2.88%
5	2	109	111	98.20%	45.68%	48.56%
6	15	56	71	78.87%	29.22%	77.78%
7	14	30	44	68.18%	18.11%	95.89%
8	2	4	6	66.67%	2.47%	98.36%
9	2	1	3	33.33%	1.23%	99.59%
10	1	0	1	0.00%	0.41%	100.00%
Total	36	207	243	85.19%	100.00%	

Table 17 shows in detail that there are not many observations for low demands, less than 4 euros, or high demands, greater than 8.[4] These observations, in fact, constitute 7% of all those of the experiment and follow a relatively linear logic: high offers, which correspond to low demands, are always accepted, while low offers are often refused. What is instead interesting is the range of Proposer demand that goes from 5 to 7 euro: it represents 93% of the observations in the experiment. In the case of perfectly fair offers, that have a relative frequency equal to 45.68% in the experiment, there is an acceptance rate equal to 98.2%.

Nevertheless, if the Proposer demands no longer 5 but 6 euros for himself, the rejection rate rises to about 22%. If he asks for 7 euros, the rate increases to about 32%.

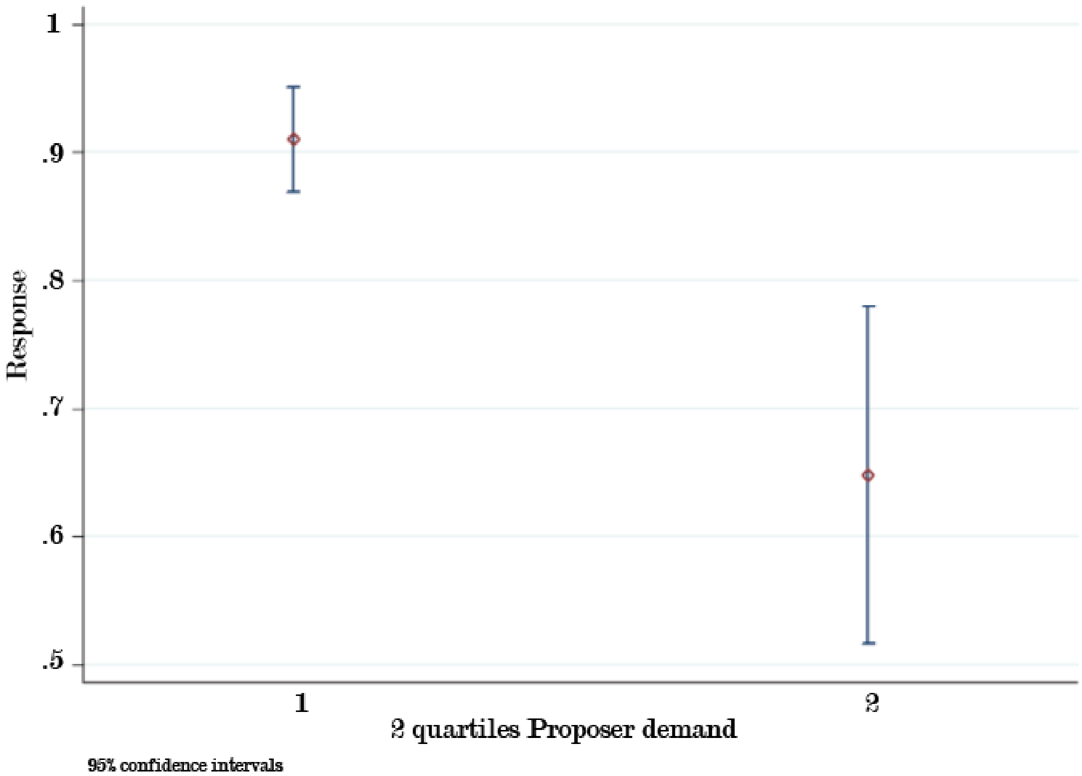
Therefore, this experiment offers preliminary evidence that follows the literature on this topic. Although the traditional theory foresees minimal offers and a percentage of

[4]This table, and the associated analysis, expands on the evidence reported by Buso et al. (2020, p.3)

accepted offers close to 100%, in the following experiment it is found that the Proposers on average offer 40%-50% of the pie to the Responders, who, despite receiving offers significantly higher than those foreseen by the traditional theory, refuse between 20% and 30% of the cases.

In order to provide a complete analysis of descriptive statistics, it has been performed a confidence interval plot to compare different groups of the sample. This analysis shows the confidence interval for the mean of the data, with a 95% confidence interval.

Figure 10: Probability of Response for Proposer Demand median in current period



The data shown in the database presented variations, which are indicated by the width of the intervals. More consistent data and less variation are shown by small intervals, while a wide interval indicates more variation.

Hence, a confidence interval plot has been executed in order to have a comparison of the Responder acceptance for the 2 quartiles of Proposer Demand, individuated by the median. The latter is described in Figure 10, which shows that the amount of variation for the second quartile seems to be significantly higher compared to the other one. Since there is no overlap between the confidence intervals, I find preliminary evidence that increasing demand significantly affects the acceptance probability. This confidence interval plots has been performed, although the Acceptance variable is dichotomous: in fact, thanks to this plot it is possible to observe the differences between the average values, not taking into account the number of observations. This is to show that there is a significant effect of the Proposer Demand above and below the median.

A preliminary analysis of the acceptance frequency per game round has also been performed in order to analyse the change in Responder behaviour over time.

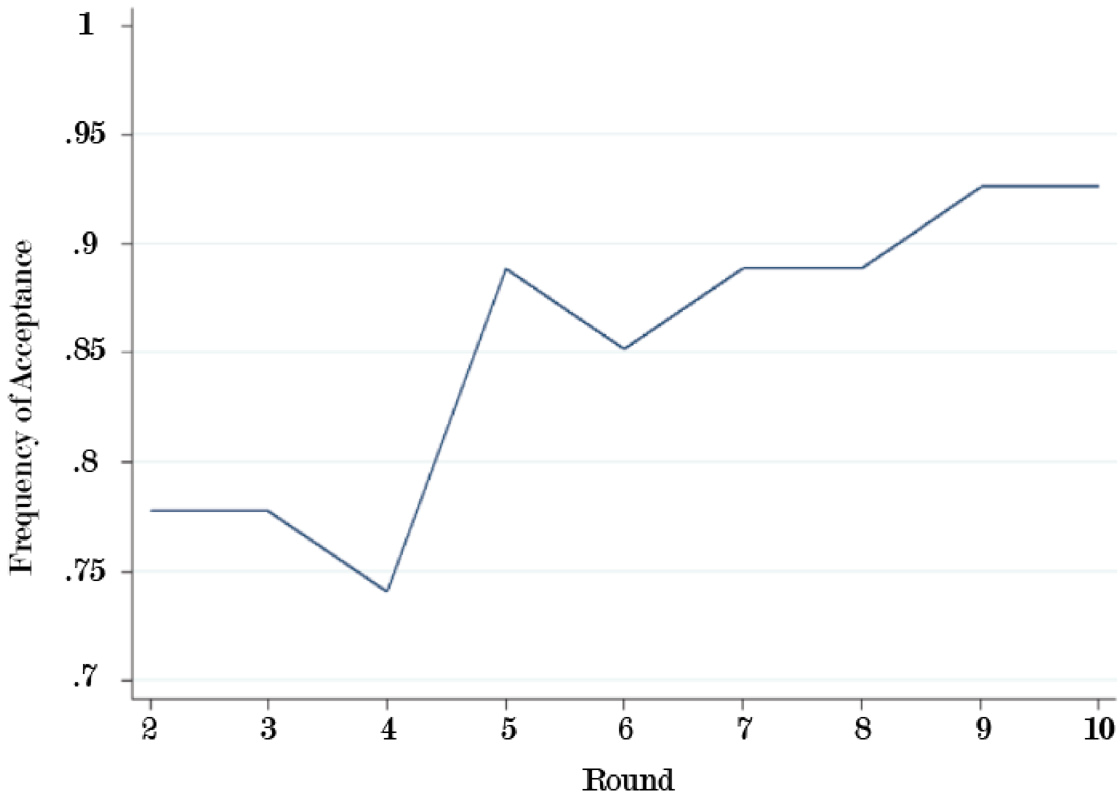


Figure 11: Frequency of Acceptance per Round

Figure 11 shows the frequency of acceptance in relation to the game rounds. At the beginning of the game it has a fluctuating and not too high trend, especially in round 4 where it reaches the minimum, about 74%. If one looks from Round 6 to 10, however, there is a substantial increase in the frequency of acceptance by the Responder. This in fact increases, and is around 93% in the two final rounds, which have been shown to be statistically significant. This result leads to state that there is probably an endgame effect.

I also analyse past choices of players. This type of analysis is allowed both by its affinity to real life events - just think of bargainers who normally interact repeatedly with the same person - and by the structure of the experiment. The latter is placed in a context where the parties are uncertain about the rationality of opponents, and must therefore learn, during repeated interactions, what kind of players they are facing.

This mechanism leads to the notion of "reputation". A player's reputation is the sum of the information about his past behaviour. It allows players to form expectations about the opponent's future behaviour based on his past actions.

Hence, rational players will behave strategically not only with respect to the game round (subgame), but also with respect to the entire game, which includes all nine rounds.

If players are selfish, they will use strategies to maximize their payoffs. Of course, playing selfishly will lead to disagreements, so low acceptance rates and higher costs for both players, as the split will not take place.

On the contrary, if players care about fairness, they try to pursue fair results as the literature suggests, these strategies are used to promote fairness. In fact, reputation can, for example, enable the Responders to report their level of acceptance more efficiently and to make it easier for the Proposers to learn that level. Moreover, if in the previous period the offers do not satisfy the Responders, they will probably reject them, influencing the offer (and therefore the acceptance) of the following period.

Therefore, the fixed pair design of the experiment could provide more earning opportunities for players.

In chapter 4.2 you will see the effects that the Proposer Demand in prior period has on the Responder Acceptance in the current period.

4.2 Econometric Analysis: Panel Logistic Regression

In order to proceed with a more satisfactory identification of the possible determinants of acceptance in the Ultimatum Game, a Panel Logistic Regression model has been used. The purpose that it is intended to pursue through the use of this regression model is to identify the variables that most explain the response given by the Responder, and what actually affects latter's tendency to fairness.

The general objective of a logistic regression is to estimate the odds that an event - in this case the acceptance by the Responder - will occur taking into account the dependency of the data. The response variable (indicated with Acceptance) taken into consideration is the Responders' decision in each round of the game. This variable can take two possible values (it is therefore a dichotomous variable): the Responder accepts the offer made by the Proposer (accepts=1) or the Responder refuses the offer made by the Proposer (accepts=0). With such a binary outcome variable, it is appropriate to perform a logistic regression, which gives the conditional probability that an outcome variable is equal to one or more predictor variables. In particular, the model was estimated using the *xtlogit* function of STATA software: this is a statistical model in which I use the random effect specification, useful when repeated measurements are made on the same statistical unit. Thus, if the measures concerning Yvar are repeated in each individual for a given number of times, it is suggested to use *xtlogit*. In this case, it is referred to longitudinal data (or panel data) that provide the observation of different variables, each in a series of time periods, i.e. the same players are observed for 9 rounds of the experiment.

The explanatory variables taken into consideration for the estimation of the model have been chosen on the basis of the descriptive analyses carried out, which have been taken into account in paragraph 4.1 and on the basis of knowledge of the phenomenon. In particular, as covariate in the regression are included: the Acceptance and Proposer Demand of the previous period, the Proposer Demand in that period and Acceptance in the first round. In addition, a vector of demographic variables has been added for simplicity, including gender, age, geographical area of origin and degree in economics of participants. Also Round is a covariate: Round 2 is excluded from the analysis because the observation is lost when analyzing the lagged value of the demand; instead, Round 3 represents the "base" value on which all the other coefficients are calculated. Moreover, in this case the fixed effect - the equal average effects for the whole sample - are those of the game session, to detect the effects that, for example, a connection problem may have among the participants.

This regression follows the econometric specification below:

$$Accept_{i,t} = \beta_0 + \beta_1 Accept_{i,t-1} + \beta_2 Dem_{i,t-1} + \beta_3 Dem_{i,t} + \tag{6}$$
$$+\beta_4 Accept_{i,t=1} + \gamma Demographics_i + Round_t$$

Table 18 shows the results of the model estimation. Among the variables studied, the most significant is the Proposer Demand in the current period, with a p value of less than 0.01. This result explains how the Acceptance variable behaves according to the Proposer Demand. In particular, the relationship between both variables is negative: as the Proposer Demand increases, Acceptance decreases and vice versa. This is closely related to the fact that the Proposer Demand is complementary to the offer itself. These findings support the hypothesis of fairness in the UG, as suggested by the literature on the subject. Therefore, offers judged unfair by the Responder suffer the rejection of the same.

With a p value equal to 0.007, the Proposer Demand in the previous period results one of the most significant variables of the model. The effect of this variable on Acceptance is positive: the greater the Proposer Demand in prior period, the greater the Acceptance in the current one. This means that maybe when an offer in the previous period is high, it is considered low and unacceptable, and probably later offers will be considered kind and will be accepted.

Furthermore, the Acceptance in the previous period also has an positive effect on the probability of Acceptance of the Responder in the current period, with a p value equal to 0.04. In particular, this leads to state that, probably, as reported in literature, repeating the same actions over time - playing more rounds with the same roles - creates in the Responder a tendency to accept more over time.

The variable "Degree in economics" also has an impact, albeit with a weaker effect, on the probability of Acceptance. This is certainly due to the intrinsic characteristics of the sample, formed by students of economics or otherwise close to economic disciplines. This variable is significant on the experiment and, in particular, on Acceptance, because there is a mindset of respondents to approach experiments of this type or, more specifically, they know the game itself. The effect of the variable is negative and indicates that those who have a degree in economics will probably tend to accept less than those who do not.

Table 18: Panel Logistic Regression Model: effects on acceptance rate

Dependent variable:	
Probability of acceptance	XT
Past choices	
Acceptance in t-1	1.570**
	(0.766)
Prop. Demand in t-1	1.302***
	(0.481)
Current choices	
Proposer Demand in t	-2.437***
	(0.491)
Gender and Age	
Gender	-0.873
	(0.774)
Age	-0.015
	(0.137)
Macro-region	
Centre	0.409
	(0.835)
North	-1.790
	(1.211)
Degree in Economics	-1.133*
	(0.592)
First UG Round	
Accept in t=1	0.272
	(0.725)
Round	
(4)	-0.273
	0.844
(5)	0.941
	0.933
(6)	0.374
	0.909
(7)	1.172
	1.030
(8)	0.468
	0.930
(9)	2.262**
	1.121
(10)	2.339*
	1.252
Session F.E.	Yes
Observations	216

Notes. XTlogit estimates of specification (6). Standard errors in parenthesis.
***$p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

I also analyse the Responder behaviour over time to understand how experience influences his decisions during the experiment. In particular, in the regression, the game rounds have been inserted, to see how observations, and particularly acceptance, change with experience.

Observing the last two Rounds of the experiment, it can be observed how the experience is statistically significant on Acceptance. With a p value equal to respectively 0.044 and 0.062, Round 9 and 10 have a positive relationship with the dependent variable: as the rounds increase, acceptance increases too. Thus, this analysis shows that individuals interacting in a finite rounds game often reach their earnings towards the end of the game. This is called endgame effect: acceptance rates rise with experience and most of this increase occurs in the last few rounds because subjects play repeated games against a fixed opponent.

Hence, this result highlights that Respondents' behaviour changes with experience, but this does not show that, in the last rounds, the Responder's behaviour converges towards the subgame perfect equilibrium of the game. This is supported by the fact that the Proposer Demand has a negative effect on Acceptance. The Responders, therefore, are not compliant with the experience, but are instead learning that low offers are "unkind" and therefore become even less likely to accept them. As a result, Proposers are no longer enticed by low offers that are rejected. In consideration of this, probably the percentage of low offers decreases even with experience.

5 Discussion

In the history of social sciences, the Ultimatum Game can be defined as one of the most successful experimental projects. Hence, an excursus of the evolution of the Ultimatum game was made, which allowed to understand how the approach to this type of game has changed over time.

In the initial experimental phase, Güth et al. (1982) wanted to study sequential bargaining and, in particular, its simplest form in order to minimize the cognitive costs of calculation. Despite the intentions of its inventors, the UG did not demonstrate the adequacy of classical theory but became a paradigm for the study of human behaviour and non-standard preferences of individuals. The results found over the years have shown that in the behaviour of UG players, there is a tendency towards fairness. In particular, it has been discovered that on average the Proposer offers more than a third of the pie, despite the classic theory claims to leave only "a crumb" of the bargaining pie to the Responder. Moreover, unfair offers are rejected despite the Responder, rather than receiving nothing, should always accept the Proposer's proposal. Subsequent studies have tried to understand whether or not the results of the Ultimatum were an anomaly and whether the fairness found in the experiments was the result of the structural conditions of the experiments or a real intrinsic condition of individuals. So what happens if the Proposer has a real right to play in such a position? What instead happens if the Responder does not have the right to accept or refuse, but must passively suffer the choice of his opponent? In these cases, dwelling on the Proposer, there are tendencies towards the subgame perfect equilibrium.

But what if the key to study the tendency towards fairness is the Responder? The Proposer acts correctly towards the Responder simply because he is afraid of rejection by the Responder, and not because of his respect for the opponent or his moral correctness. In the Responder's response, however, the notions of what is "fair" and what is "punishment" are inherent. But what are the latter dictated by? Probably by psychological factors, emotions, but also culture and social norms.

Does the experience affect it? Yes, even if the context and the number of data play a fundamental role in the identification of such effects.

The study aimed at studying the Responder behaviour in the Ultimatum Game, in a way not dealt with until now. Since its elaboration took place during the Covid-19 pandemic, the Laboratorio CESARE allowed me to study the Ultimatum Game phenomenon in a completely online way. Forced to lock-down, all the platforms and all the steps necessary to perform an experiment as close as possible to that of a physical laboratory were tested and I took part in this experience.

The hypotheses of the analysis are to inspect the Responders' behaviour and how it is affected by different factors such as offer and acceptance in the previous period or by current ones, taking into account different demographic factors such as age, gender, geographical area of origin and degree of individuals. In addition, I wanted to see what role experience plays in experimental situations such as this. It was shown that the Proposer Demand in the current period is negatively statistically significant on acceptance: this means that as demand increases, the Responder tends to reject offers. It is the proof that the mechanism of altruistic punishment, which the Responder implements in the name of fairness, manifests itself.

Even past choices influence the Responder's decisions: if the Responder accepts in the previous period, it is likely that it will also accept in the current period. Nonetheless, the Proposer demand of the previous period has a positive effect on the acceptance of the current period: the greater the demand in the previous period, the greater will be the acceptance in the following period.

Even in the case of experience, the offers in the dataset do capture what the literature suggests - namely that as experience increases, acceptance increases. This is probably an endgame effect, due to the repeated interactions between the same players over time.

6 Conclusion

The next steps of this study will certainly start from its strengths: the innovation given by the new online research methodology should be expanded and consolidated, so as to make it exploitable in the future. The intrinsic advantages of the online mode of execution, such as the ease of finding a large and heterogeneous sample and the speed of execution of the experiment, will facilitate the conduction of experiments. Today the sample used is strongly homogeneous, composed of students from 20 to 30 years old with an economic background. Tomorrow, taking advantage of this mode, we can have a strongly heterogeneous sample from the socio-demographic point of view, which will allow us to have a more truthful experimental view of reality. In the case of the experiment mentioned before, an improvement of the online methodology could lead to capture more shades in the behaviours and characteristics of Responders and in the offer of Proposers, thus capturing the true meaning of reciprocity, equity and fairness.

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Abstract

Introduction

The Ultimatum Game is the simplest non-cooperative bargaining game used in experimental economics to study human behaviour in bargaining situations. This game was first studied experimentally by three German economists, Güth, Schmittberger and Schwarze at the University of Cologne in 1982.

The Ultimatum Game (henceforth UG) is a game with perfect and complete information, in which players are endowed with perfect rationality. In this game, two players interact to decide how to divide a monetary amount between them. More specifically, one player, the Proposer, is provisionally endowed with a monetary sum. He is asked to divide this sum of money with another player, the Responder. The latter has the possibility of accepting or rejecting such distribution. If the Responder accepts the offer, they will both receive the sum established by the proponent beforehand. If the Responder refuses, both players receive nothing.

Following game theory, a finite game with complete information and perfect rationality of players as UG implies that the one who makes the offer gives the other player the smallest positive amount of the sum to be divided, to maximize his utility.

Nevertheless, comparing empirical data of Güth et al.'s experiments with the predictions of theoretical models, some discrepancies have been observed. In fact, experimental results have highlighted that individuals do not always behave according to the equilibrium solution, but they can deviate from the optimal decisions. This is where the dualism between descriptive and normative theories is investigated. The former tries to find out how decisions are taken in different operational contexts; the latter analyses the way decisions should be taken by referring to ideally rational agents.

Moreover, an excursus of the evolution of the UG will be made, which allowed to understand how the approach to this type of game has changed over time.

At the end of the work, the methodology and results of a lablike experiment carried out to understand the Responder's behaviour in UG will be reported.

1 The Ultimatum Game: from Rationality to Fairness

The First Chapter aims to report the salient theoretical models of the classical theory of the UG, in particular the cases with discrete and continuous offers. It will then proceed with the extensions of the game necessary for the understanding of the players' behaviours in games repeated over time. At the end, it will describe the experiments that led the creators of the UG to introduce the concept of fairness in their studies.

As far as the theoretical model with discrete offer is concerned, it can be said that this type of UG has an finite number of subgames. The theoretical solution of a one-round bargaining game with discrete offers is intuitive. Since this game has a finite horizon, it can be used backward induction to find its subgame perfect equilibria (i.e SPNE). The game has two subgame perfect equilibria: the first one in which player 1 proposes that he gets all c and player 2 agrees to all proposals; the second one in which player 2 plans to reject only the proposal that gives him no units and player 1 proposes that player 2 gets exactly one unit. The correspondent game payoffs would be (c, 0) in the first case and (c-1, 1) in the second one. Hence, the game has multiple Nash equilibria: for any allocation, the game has such a Nash equilibrium that player 1 proposes the split and player 2 accepts that allocation and rejects the others; also, the pair of strategies in which player 1 keeps the whole sum for himself is a Nash equilibrium, which produces disagreement.

What if the "bargaining pie" is infinitely divisible? This is the case of theoretical model with continuous offers and it can be said that this UG has an infinite number of subgames which start from any possible offer of the Proposer. Since player 1's optimal demand is almost the whole "pie", leaving only a crumb of the "pie" c for player 2, if the offers are continuous, there will always be a better proposal for player 1. It can be said that the unique SPNE of the game is the pair of strategies in which player 1 offers 0 and player 2 accepts all offers.

The UG described so far is the simplest version of a bargaining model. Since it is so simple, it has some inherent controversies. For this reason there are different ways in which the theory can be expanded. One of the most realistic is to explicitly model multiple offers and counter offers of the parties over time. For the reasons stated above, it is crucial to introduce a discount factor $\delta \in (0, 1)$ for each player in the infinitely repeated games. Each player discounts the future payoff by the discount factor. In the UG, the last period of game directly affects the players' strategic considerations: a punishment phase which lasts for a limited period ensures that players will return to pursue the best possible result in next periods. So, it is better analysed as infinitely repeated games because the player plays almost ignoring the final round, and his thread of reasoning is then shaped by the infinitely repeated game. Two players have to split a sum c between them, which this time is normalised to 1. The players alternate themselves in making the offer, starting with player 1. Basically, if the offer is rejected in the first period and the analysis begins in the second period, the game will again be a standard UG with the reversed roles, and so on. It is important to underline that to achieve a common value equal to 1, the equilibrium of the game of alternating offers involves the agreement made in the first period, so an immediate agreement. For instance, if an agreement is reached only in the second period, then the common value will be $\delta_1 x_2 + \delta_2(1 - x_2)$, which is strictly less than 1. How to find a stationary equilibrium of an infinite time game? The equation that makes player 2 indifferent between accepting and rejecting is $\delta_2(1 - x_1) = x_2$. Since this equation can be applied to both players, solving the system of equations it is shown that the equilibrium is characterized by an agreement in the first period and produces a return of $\frac{(1-\delta_2)}{1-\delta_2\delta_1}$ for player 1 and $\frac{\delta_2(1-\delta_1)}{1-\delta_2\delta_1}$ for player 2.

It can be argued that the specialty of the UG is not about computation of the subgame equilibrium points, but about analysing the different aspects of human behaviour in the context of a bargaining situation.

The pioneers of the experimental analysis of the UG are Güth et al. (1982), which implemented a experiment divided into two subgroups. The core of the first group of experiments is the simplest UG model, where two players have to decide how to divide a certain amount of money. Instead, the second group of experiments is based on a more complicated game, where two players have to distribute a certain amount of black and white chips between them, which are not of equal value for both. Hence, the different name of the two subgroups: the first is called "easy games", the second "complicated games".

Güth et al.(1982) have shown that facing real-life choices, individuals do not possess a Von Neumann Morgenstern utility function, i.e. they simply do not react to maximize their utility. Other factors occur in real life that lead individuals to make choices in contrast with the perfect rationality of classical game theory.

Although the intrinsic nature of the experiment leads one to think that an individual who possesses nothing is willing to accept even the lowest possible offer in order to improve his or her position, in real circumstances the concept of fairness takes over. Consequently, the rejection of the proposal - judged unfair by the Responder - is considered the "correct punishment" for the greedy Proposer. At the same time, the Proposer is aware that unfairness could lead the Responder to reject his offer: hence, the Proposer tends to offer relatively equal division than the ones classic game theory suggests.

2 Ultimatum Game: a Selective Survey of the Literature

UG is the simplest bargaining games from a structural point of view but one of the behaviourally most complex. In fact, the motivations behind players' decisions are varied, they go beyond the simple maximization of utility that classical theory affirms and have attracted the attention of researchers who have long been working to understand them.

In everyday life the actions taken by individuals are conditioned, they are not perfectly rational, and even subtle accidental moods can play an important role in the decision-making process. In the same way, it is impossible to think that, when faced with an experimentally designed choice, people can react one hundred percent freely and not behave in a way that is affected by the situation itself. If in real life there are feelings, moods and much more that can lead to cognitive bias and decisions taken in an illogical way, in the same way mechanisms take over in the laboratory that cannot achieve the highest-quality of research possible, and instead create distortions.

This is the reason why the UG has become a multidisciplinary tool for the study of different themes and it has provided a bridge between economics and other social sciences. Covering the last forty years, this extensive publication of experiments and variations of UGs have tried to bridge the discrepancies between experimental and theoretical results, modifying the structure of the experiment or specifically studying the behaviour of Proposer and Responder.

The UG can be considered among the so-called "anomalies" by Thaler (1988), i.e. everything that is not perfectly in line with the cause-effect logic that influences the strategies that an individual adopts every day. On the contrary, advocates of the opinion that equity-driven behaviour is not stable, i.e. "it can be easily displaced by simple optimazing behaviour" and it is only an experimental exception, are Binmore, Shaked and Sutton (1985). The latter describe two extreme positions: that of the "fairmen" who divide everything in equal parts, and that of the "gamesmen", who behave in a selfish and rational way as real economic agents.

The trend towards the concept of fairness is not easy to believe and that is why researchers have tried to study the game from several perspectives, so that fairness is not an exception.

Researcher wondered whether such fairness could be a consequence of the endogenous endowment given to players, and not the result of the intrinsic characteristics of individuals. So, what if it is the "cake" given by the researcher that raised such strong concerns about equity? Güth and Tietz (1986) eliminate endogenous allocation of participation rights and use auctions to allocate the right to play in the UG: competing and winning in an auction creates a stronger sense of entitlement than simply awarding participation rights. Hence, the results of Güth and Tietz (1986) challenge the backward induction and do not verify subgame perfect Nash equilibria of the game.

Another strong contribution to the analysis of UG was made by Neelin, Sonnenschein, and Spiegel (1987). Their experiment was done in response to the results of Binmore et al. (1985), to support the concept of fairness that emerged from the experiment of 1982. The subjects in Neelin et al.'s experiment (1987) played a series of multi-period UGs (two, three and five-period bargaining). The results of these three cases led to different conclusions. The two-period game had similar results to Binmore et al. (1985). Nevertheless, in the case of three-period game and five-period game, the results were completely different: more than 50% of participants reached a fair division.

The most articulated experiment of this kind in the history of experiments conducted so far is reported in Ochs and Roth (1988). Also the results of these experiments prove that the subgame perfect nash equilibria of game theory lose the predictive role given to it.

But who is most influenced by the so-called sense of fairness? The two players are not influenced in the same way: the Proposer is inclined to act correctly towards the Responder, but this is not exclusively due to his respect for the other party or his moral integrity, but rather to his fear of retaliation by the Responder, who may decide to sacrifice his gain, in order to punish the opponent's behaviour, judged unfair and therefore offensive. So, what if the Responder does not have the right to accept or reject the offer? Does equity also exist when the risk of rejection is eliminated? Kanheman, Knetsch and Thaler (1986) conducted two experiments: one that replicated the UG of Güth et al. (1982) and one called Dictator Game (DG). The conclusions of their experiments state that equity exists also when the risk of rejection is eliminated, as one can see in DG. Even in this case, positive offers are made by the Proposer, leading to the conclusion that who allocates the amount is guided by a sense of equity, supporting the theoretical position underlying the conceptualizations of equity theory.

Hoffman et al. (1994) recognized that another important factors can be reputation: "maintaining reputation might create expectation that change Proposers' behaviour". The results shows that are completely different from previous literature: as social distance between players and experimenters increases, offers to Responders decrease. So, equity and reciprocity are also enforced by the power of isolation.

So far, the question that researchers put at the basis of their experiments is: "Why do respondents reject positive offers?". Now, Cooper et al. (2011) dwell on how the Responder's behaviour changes with experience and how this can lead to fairness. In particular, they understood that repeated games can create a learning mechanism in participants. The main result of Cooper et al. (2011) meta-analysis is that acceptance rates change over time. The results therefore show that respondents' behaviour changes with experience: high offers are more likely to be accepted and low offers are less likely to be accepted. Both players know that if the Responder refuses, both will take nothing. In the experience of both, when an offer is considered high and acceptable, the offer will be accepted, and for this same experience, later offers will be rejected and vice versa.

In the literature, it has also been investigated whether subjects' behaviours in UG is systematically related to the countries where the subjects themselves live and from which they have developed their culture and learned social norms. In fact, several experiments have been conducted in different parts of the world with very strong cultural heterogeneity, to understand what the thresholds of equity are and whether they differ from population to population. For example, Henrich (2000) conducted an ultimatum bargaining between the Machiguenga tribes of the Peruvian Amazon, Bahry and Wilson (2006) developed an experiment in two multi-ethnic republics of Russia while Roth et al. (1991) showed difference between subjects in Israel and Japan compared to that of Slovenia and the U.S. Oosterbeck et al. (2001) have collected in a single article the results of 32 experiments conducted in different areas of the world. They found no significant differences in the Proposers' behaviour between regions. The behaviour of the Responder, however, is different from country to country.

3 The Experiment

The data used in the experiment have been kindly granted to me by Prof.ssa Di Cagno and the other researchers who have dealt with this experiment. The results of the research in which these data are involved are currently being published (see Buso et al. (2020)).

In the following chapter will be described the experimental setting and its main characteristics. The originality and innovation of this study lie in the experimental methodology. Everything stems from the need to cope with the forced impossibility to carry out live experiments due to Coronavirus epidemic's outbreak in China between the end of 2019 and the beginning of 2020. What appeared to be a localized epidemic, however, turned out to be a global pandemic in the following months. The spread of Covid-19 affected the whole world and at the end of February 2020 Italy became the second country with the highest number of cases. Thus, on March 9, 2020 was issued the Prime Minister's Decree that brings new measures to contain and contrast the spread of the virus throughout Italy and which led to the suspension of several production activities, universities and even quarantine. This situation has strongly impacted on everyday life. Due to the legislative dispositions, the online has been given space, also from an experimental and scientific point of view.

This experiment is a result of this new perspective. It took place at CESARE ON LINE, the virtual Centre for Experimental Economics of LUISS Guido Carli in Rome.

Before performing the experiment on the UG, several attempts were made to make the experiment as close as possible to the existing physical laboratory mode and to refine its methodology. During the test of the experiment, some student volunteers were called to evaluate the functionality of the platforms and their availability, to ensure transparency, anonymity, and a proper monitoring of experimental subjects, "de facto" replicating a physical laboratory environment.

Each participant followed several steps: they all registered to Prolific platform, thanks to which they were provided with their own ID and compensated at the end of the experiment; they had to be equipped with their own webcam device to allow monitoring through WebEx and Veconlab - the platforms used to create virtual cubicles and monitor the participants and to carry out the experiment and collect the participants' data respectively - by experimenters, and to maintain a video and audio contact for the entire duration of the session, otherwise they would be excluded from the experiment.

There were 3 sessions, respectively on April 21st, 22nd and 24th. These three sessions were attended by 54 participants, all undergraduate and graduate students of Luiss Guido Carli. In summary, the methodological innovation of the study is to conduct a scientific experiment as close as possible to that performed in a physical laboratory but online.

Individual payment was made conditional upon the participant filling out of a mandatory survey including demographic questions needed for the research. Each subject received a participation fee equal to 6 euros, plus the actual gain during the experiment. The payoffs of each round were expressed in dollars, but the final payment for each participant was converted into euros with a conversion rate equal to 150%, i.e. 1 dollar = 1.5 euros. The actual payment of the experiment was equal to 10% of the accumulated earning in the experiment.

The experiment consists of two Phases. At the beginning of the experiment, each participant is automatically assigned the roles of Proposer or Responder, which will be maintained for both Phases. The pairs of participants are formed once in Phase 1 and then formed again by the computer in Phase 2 and will remain the same.

Phase 1 has a DG design consisting of only one round. The computer assigns randomly and anonymously participants to the role of Proposer or Responder. As in DG, the decision made by the Proposer determines the payoffs, and therefore the earnings, of both players. The Responder, however, does not have to make any decisions at this stage. The amount that the Proposer has to divide between himself and the Responder is equal to $10. In particular, he will have to choose the part to keep for himself, determining the amount for the Responder accordingly.

Phase 2 is composed of 9 rounds and it has the structure of a UG. Although the roles are the same - who was Proposer/Responder in Phase 1, has the same role in Phase 2 - pairs are different and chosen randomly and anonymously by the computer, as previously mentioned. At the beginning of each round, the Proposer has to choose how to divide $10 between the Responder and himself. In particular, he is asked to choose which part of the endowed amount he wants to keep for himself.

In both Phase 1 and Phase 2, the Proposer can only choose integer values between $0 and $10, extremes included.

In Phase 2, the Responder, having known the split, decides whether to accept or reject the offer. In the first case, the split takes place and each participant earns for that round the amount that the Proposer has previously determined. In the second case, both members of the pair earn $0.

At the end of each round, each player will know the other's choice and their relative payoff. At the end of Phase 2, Proposer and Responder will receive a survey via e-mail necessary to make the payment available. Consequently, the 10% of the cumulative gain realized during the whole experiment will be shown in the participants' Prolific account within a few hours after the end of the experiment.

4 Data Analysis

The analysis of the dataset are conducted using STATA. It begins with the study of descriptive statistics, which are used to inspect the data.

The analysis of the data will be focused on the UG: in particular, I will analyse the Responders' behaviour and how it is affected by different factors such as Proposer Demand in current and prior period, Acceptance in prior period, region, macro-region, gender, age and degree. There are 243 observations available out of 270, which are equivalent to 9 rounds of game for 27 players.

First of all, the analysis includes demographic variables collected with the final survey, which allows to control the effect that some individual characteristics may have on the probability of observing acceptance or rejection. Specifically, the survey contained demographic questions to collect information on the background of players, which allow experimenters to know more deeply the target audience and to segment them according to who they are, where they live, their gender, knowledge of English, age and whether the participant is pursuing a degree in economics. The average age of the sample is around 23 years, with a minimum of 19 and a maximum of 30. However, about 70% respondents declare they have an advanced level in English, while the remaining 30% have an intermediate level. As far as gender of the participants is concerned, more than half of the sample is male, with a total of 15 males out of 27, which is the 55% of the sample. From a geographical point of view, the subjects who participated in the experiment were divided into 3 macro geographical areas: 51.85% comes from central Italy, followed by the 40.74% from southern Italy and islands, and the remaining 7.41% from northern Italy. However, the dichotomous variable "Degree in economics" shows that about half of the participants has a degree in economics.

I also analyse how the Proposer demand affects the Responder's behaviour. I find preliminary evidence of the Proposer demand on the current and past periods and the Responder's decision. The average Proposer Demand, considering all the games in the dataset, is equal to 5.765, and it presents a maximum of 10 and a minimum of 3 euros.

The acceptance rate, instead, is a dichotomous variable, i.e. 1 corresponds to acceptance and 0 to rejection, and its mean is 0.852: approximately, 8 out of 10 proposals were accepted over the course of the experiment.

36 out of 243 observations represent the Responders' rejection of an average offer of 3,28 euros. Specifically, the portion of the pie requested by Proposers for themselves in these 36 rejected rounds follows a minimum of 5 euros and a maximum of 10 euros. Therefore, the rejected offers are between 0 and 5 euros, presumably because of their unfair nature. On the other side, 207 out of 243 observations are related to the acceptance by the Responder to an average offer of 4.40 euros. In particular, the minimum offer is equal to 1, the maximum to 7.

Going deep into the analysis of the Proposer demand, it is possible to divide the above observations by demand levels, in order to effectively understand which offers have been made more frequently and which is the acceptance rate of that particular offer. Low demands, less than 4 euros, or high demands, greater than 8 constitute 7% of all those of the experiment and follow a relatively linear logic: high offers are always accepted while low offers are often refused. What is instead interesting is the range of Proposer demand that goes from 5 to 7 euro: it represents 93% of the observations in the experiment. In the case of perfectly fair offers, that have a relative frequency equal to 45.68% in the experiment, there is an acceptance rate equal to 98.2%. Nevertheless, if the Proposer demands no longer 5 but 6 euros for himself, the rejection rate rises to about 22%. If he asks for 7 euros, the rate increases to about 32%. Therefore, although the traditional theory foresees minimal offers and a percentage of accepted offers close to 100%, in the following experiment it is found that the Proposers on average offer 40%-50% of the pie to the Responders, who, despite receiving offers significantly higher than those foreseen by the traditional theory, refuse between 20% and 30% of the cases.

In order to provide a complete analysis of descriptive statistics, it has been performed a confidence interval plot for the mean of the data - although the Acceptance variable is dichotomous - to compare different groups of the sample, with a 95% confidence interval. This plot has been executed in order to have a comparison of the Responder acceptance for the 2 quartiles of Proposer Demand, individuated by the median. The latter shows that there is a significant effect of the Proposer Demand above and below the median.

Observing the frequency of acceptance's trend in relation to the game rounds, it is possible to notice that at the beginning of the game it has a fluctuating and not too high trend, especially in round 4 where it reaches the minimum, about 74%. If one looks from Round 6 to 10, however, there is a substantial increase in the frequency of acceptance by the Responder. This in fact increases, and is around 93% in the two final rounds, which have been shown to be statistically significant.

I also analyse past choices of players. This type of analysis is allowed both by its affinity to real life events - just think of bargainers who normally interact repeatedly with the same person - and by the structure of the experiment. The latter is placed in a context where the parties learn, during repeated interactions, what kind of players they are facing. This mechanism leads to the notion of "reputation". If players are selfish, they will use strategies to maximize their payoffs, even if this could lead to disagreements. On the contrary, if players care about fairness, they try to pursue fair results as the literature suggests, these strategies are used to promote fairness. For instance, if in the previous period the offers do not satisfy the Responders, they will probably reject them, influencing the offer (and therefore the acceptance) of the following period. Therefore, the fixed pair design of the experiment could provide more earning opportunities for players.

In order to proceed with a more satisfactory identification of the possible determinants of acceptance in the UG, a Panel Logistic Regression model has been used. The pursue is to identify the variables that most explain the response given by the Responder, and what actually affects latter's tendency to fairness.

The response variable is the Responders' decision in each round of the game. This variable can take two possible values (it is therefore a dichotomous variable): the Responder accepts the offer made by the Proposer (accepts=1) or the Responder refuses the offer made by the Proposer (accepts=0). With such a binary outcome variable, it is appropriate to perform a logistic regression, which gives the conditional probability that an outcome variable is equal to one or more predictor variables. In particular, the model was estimated using the *xtlogit* function of STATA software, a statistical model in which I use the random effect specification, useful when repeated measurements are made on the same statistical unit. In this case, it is referred to longitudinal data (or panel data) that provide the observation of different variables, each in a series of time periods, i.e. the same players are observed for 9 rounds of the experiment.

The explanatory variables taken into consideration for the estimation of the model have been chosen on the basis of the descriptive analyses carried out and on the basis of knowledge of the phenomenon. In particular, as covariate in the regression are included: the Acceptance and Proposer Demand of the previous period, the Proposer Demand in that period and Acceptance in the first round. In addition, a vector of demographic variables has been added for simplicity, including gender, age, geographical area of origin and degree in economics of participants. Also Round is a covariate: Round 2 is excluded from the analysis because the observation is lost when analyzing the lagged value of the demand; instead, Round 3 represents the "base" value on which all the other coefficients are calculated. Moreover, in this case the fixed effect - the equal average effects for the whole sample - are those of the game session, to detect the effects that, for example, a connection problem may have among the participants. This regression follows the econometric specification below:

$$\begin{gathered} Accept_{i,t} = \beta_0 + \beta_1 Accept_{i,t-1} + \beta_2 Dem_{i,t-1} + \beta_3 Dem_{i,t} + \\ + \beta_4 Accept_{i,t=1} + \gamma Demographics_i + Round_t \end{gathered} \tag{1}$$

Among the variables studied, the most significant is the Proposer Demand in the current period, with a p value of less than 0.01. This result explains how the Acceptance variable behaves according to the Proposer Demand. In particular, the relationship between both variables is negative: as the Proposer Demand increases, Acceptance decreases and vice versa. This is closely related to the fact that the Proposer Demand is complementary to the offer itself. These findings support the hypothesis of fairness in the UG, as suggested by the literature on the subject. Therefore, offers judged unfair by the Responder suffer the rejection of the same.

With a p value equal to 0.007, the Proposer Demand in the previous period results one of the most significant variables of the model. The effect of this variable on Acceptance is positive: the greater the Proposer Demand in prior period, the greater the Acceptance in the current one. This means that maybe when an offer in the previous period is high, it is considered low and unacceptable, and probably later offers will be considered kind and will be accepted.

Furthermore, the Acceptance in the previous period also has an positive effect on the probability of Acceptance of the Responder in the current period, with a p value equal to 0.04. In particular, this leads to state that, probably, as reported in literature, repeating the same actions over time - playing more rounds with the same roles - creates in the Responder a tendency to accept more over time.

The variable “Degree in economics” also has an impact, albeit with a weaker effect, on the probability of Acceptance. This is certainly due to the intrinsic characteristics of the sample, formed by students of economics or otherwise close to economic disciplines. This variable is significant on the experiment and, in particular, on Acceptance, because there is a mindset of respondents to approach experiments of this type or, more specifically, they know the game itself. The effect of the variable is negative and indicates that those who have a degree in economics will probably tend to accept less than those who do not.

I also analyse the Responder behaviour over time to understand how experience influences his decisions during the experiment. In particular, in the regression, the game rounds have been inserted, to see how observations, and particularly acceptance, change with experience. Observing the last two Rounds of the experiment, it can be observed how the experience is statistically significant on Acceptance. With a p value equal to respectively 0.044 and 0.062, Round 9 and 10 have a positive relationship with the dependent variable: as the rounds increase, acceptance increases too. Thus, this analysis shows that individuals interacting in a finite rounds game often reach their earnings towards the end of the game. This is called endgame effect: acceptance rates rise with experience and most of this increase occurs in the last few rounds because subjects play repeated games against a fixed opponent.

Hence, this result highlights that Respondents’ behaviour changes with experience, but this does not show that, in the last rounds, the Responder’s behaviour converges towards the subgame perfect equilibrium of the game. This is supported by the fact that the Proposer Demand has a negative effect on Acceptance. The Responders, therefore, are not compliant with the experience, but are instead learning that low offers are ”unkind” and therefore become even less likely to accept them. As a result, Proposers are no longer enticed by low offers that are rejected. In consideration of this, probably the percentage of low offers decreases even with experience.

5 Conclusion

The analysis aimed at studying the Responder behaviour in the UG, in a way not dealt with until now. Since its elaboration took place during the Covid-19 pandemic, the Laboratorio CESARE allowed me to study the UG phenomenon in a completely online way.

The hypotheses of the analysis are to inspect the Responders' behaviour and how it is affected by different factors. It was demonstrated that if the Proposer Demand in the current period increases, the Responder tends to reject offers. It is the proof that the mechanism of altruistic punishment, which the Responder implements in the name of fairness, manifests itself.

Even past choices influence the Responder's decisions: if the Responder accepts in the previous period, it is likely that it will also accept in the current period. Nonetheless, the greater the Proposer demand of the previous period, the greater will be the acceptance in the following period.

Even in the case of experience, the offers in the dataset capture what the literature suggests - namely that as experience increases, acceptance increases. This is probably an endgame effect, due to the repeated interactions between the same players over time.

The next steps of this study will certainly start from its strengths: the innovation given by the new online research methodology should be expanded and consolidated, so as to make it exploitable in the future. The intrinsic advantages of the online mode of execution, such as the ease of finding a large and heterogeneous sample and the speed of execution of the experiment, will facilitate the conduction of experiments. Today the sample used is strongly homogeneous, composed of students from 20 to 30 years old with an economic background. Tomorrow, taking advantage of this mode, we can have a strongly heterogeneous sample from the socio-demographic point of view, which will allow us to have a more truthful experimental view of reality. In the case of the experiment mentioned before, an improvement of the online methodology could lead to capture more shades in the behaviours and characteristics of Responders and in the offer of Proposers, thus capturing the true meaning of reciprocity, equity and fairness.