The ultimatum game: A comprehensive literature review

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Abstract.

The ultimatum game (UG) is an outstanding game which shows how people behave against rational strategies suggested by game-theory analysts. In the classic kind of this game, one person plays as "proposer" who is supposed to split a determined amount of money between himself/herself and another person who called "responder". If the responder accepts the suggested amount of money, then the proposal in implemented and the game is terminated but if the responder rejects the proposal both will receive nothing and the game is terminated. Different extension of this game i.e. dictator game, pirate game, three person game, etc. have been introduced by researchers and also different factors such as size of stakes, fairness, age, etc. have been studied in order to better analyze the behavior of the players throughout the game. Since this game could be used as the base of many economic and/or social theories and on the other hand a comprehensive review over extensions and/or different factors have never been published, in this paper a comprehensive review of the related papers covering around 30 years of time interval is provided.

Keywords: ultimatum game, dictator game, trust game, pirate game, fairness, equity.

1. Introduction

The classic UG has been first introduced by Güth et al. [1] in which the proposer has the authority to split a pie between herself and a responder. Then the responder is free to accept or reject the proposal under this condition that if the responder accepts the proposal, the pie is divided according to the proposal; otherwise, both players receive nothing. If one replaces $10 by the pie and also just integral multiple of $1 (i.e. $1, $2 to $10) be set as the size of proposal, the sub-game perfect Nash equilibrium (or Stackelberg equilibrium) for this game will be a game in which the proposer offers $1 to the responder and keep $9, and the second player accepts the proposal since $1 is surely better than nothing.

The interesting aspect of this story comes from this fact that in the real situations, rarely the human behave as discussed equilibrium. In fact, when experiments are conducted with human subjects, acceptance of small amount of money is rarely observed [2]. This is an outstanding example of how human behavior differs from game-theoretic analyses that use the “rational actor” model.

Copious evidence admitted that people are willing to “burn money” so that punish unfair behavior by others. Since the full explanation of the sidelong reasons of this phenomenon is beyond the scope of this study, it is preferred to just catch a quick glimpse about the main reasons. Among different explanations, some believe that this event stem from inexperience of the subjects in this game, not having enough processing power to thoroughly analyze the strategic interactions. They believe if people are allowed to play game many times and accordingly develop expertise over time, they eventually learn and play the sub-game perfect Nash equilibrium.

However, different experiments have generally rejected this theory [3]. On the other hand, some explanations assert that cooperating of the subjects via some innate neurologically-based process make them receive positive utility. Opposite to this reason, experiments have shown that people from different cultures play the UG differently which support this fact that the internal process of decision making in the game is not innate at birth. For instance, tribal members from the Machiguenga Indians in the Peruvian Amazon do not show any inclinations towards the fairness while the sense of fairness is commonly observed in developed, industrial societies [4].

This study consists of a systematic review of related empirical articles published between years 1982 to 2013. For this purpose, around 85 papers in this time interval were collected and among them around 40 empirical papers were approved qualified for being review. The review process includes two parts (1) to classify different kinds of UG and find out the distinctions and (2) to identify the main explanatory variables.
which determine the outcome of the game. This will clarify convergence and divergence of the studies and will broaden our knowledge of human behavior and its impact on economic theories and as a result to better channel future research.

The rest of the paper is organized as follow. In section 2, different kinds of UG such as social ultimatum game, dictator game, trust game, pirates game and three-person ultimatum game is described. Afterwards, in section 3 different factors and their impacts on UG are fully explained and finally, some concluding remarks are presented in section 4.

2. Different kinds of ultimatum game

As first step to uncover literatures concerned with ultimatum game, we have to identify various kinds of this game which are introduced by Scholars heretofore. We distinguished five different versions of ultimatum game including: (1) social ultimatum game, (2) dictator game, (3) trust game, (4) pirates game and finally (5) three-person ultimate game. In this section, we briefly review the characteristics of each abovementioned games and also describe sub-perfect Nash equilibrium of this game (if any) and compare expected results with real results.

2.1. Social ultimatum game

Social ultimatum game (SUG) was first introduced by Chang et al. [2]. The main difference of this game to the classic game is that in SUG players can choose their partner among a society of agents, and engage in repeated interactions of the classic game. As expected, human players do not behave according to simple equilibrium analysis predictions. Almost no one attempts to offer only $1, and when it is attempted, the offer is summarily rejected. Both the distribution of offer amounts and corresponding rejection rates generally resemble the distributions observed in the standard ultimatum game. That is, we do not see a complete shift towards game theoretically rational strategies: low offers are still rejected, and for the most part, near-fair offers are the most common offers made. However, there are some clear differences. First, the mode of the offers in the SUG is $4 while the mode in the standard ultimatum game is $5. It shows that in the social ultimatum game players behave more flexible.

Second, and perhaps more surprisingly, players actually offer more than $5 in a fair percentage of the time (roughly 15%). This makes sense due to the repeated nature of the game. This kind of human strategizing is exactly the creative and subjective modeling that humans are capable of performing, but that machines cannot yet emulate. Humans intuitively understand that a high offer, say $8, makes a big impression on the recipient, potentially causing the recipient to act more favorably in response. Interestingly, based on SUG, the web based game which then is optimized for easy-to-use touch-based devices such as iPad is generated.

2.2. Dictator game

The dictator game (DG) is a simpler form of the ultimatum game, where one player (the allocator) receives an amount of money and makes a unilateral decision how to divide it. The other player (the recipient) must accept this split of the pie. Once again, on the assumption that people are only concerned with maximizing own monetary payoffs, the unique Nash equilibrium is for the allocator to take all the money for himself/herself. Two main conclusions emerge from the literature on this game (e.g. [5-8]). First, the equilibrium prediction is not supported by most of the data, and second, results are very sensitive to the experimental procedure (see the surveys in [9, 10]).

2.3. Trust game

The “trust game” (TG) or “investment game” (IG) was first proposed by Berger et al. [11]. In this game there are two participants that are anonymously paired, both participant are given an amount of money, the first player have to transfer some or all of his endowment to the second player (the amount sent may be zero), this transfer is tripled by the experimenter and handed to the second mover, and finally the second player may return
some or all of the received transfer. In fact, “first-mover transfers are interpreted as a manifestation of trust, and second-mover transfers as a manifestation of trustworthiness [12]”. Based on economic assumptions of rational self-interest, the amount of money transferred by first player would be zero even if he or she is well informed about the design of the game [11], however actual results acknowledge the deviation of real observed results from the predicted results by economic theories. The findings of the real world experiments shows that amount of money sent back by first mover averaged slightly over fifty percent of their original endowment [11].

2.4. Pirate game

Pirated game (PG) is considered as a multi-player form of ultimatum game, assumes players as self-interested actors in human economic concepts. The game consists of five rational pirates namely A, B, C, D and E between whom there is an order of superiority i.e. A is superior to B, who is superior to C, who is superior to D, who is superior to E. In this game, the pirates are going to distribute 100 gold coins between each other and the rule of distribution is as follow: the most senior pirate, suggest a method of allocation then the others including the proposer vote on whether to accept this proposal or not. If they approved this distribution then the game is finished and the coins are allocated based on the proposed method, otherwise the proposer will be killed (eliminated from the game) and the next most senior pirate makes a new proposal to begin the system again. Each player in this game have to take into account three different factors: first of all he or she must survives, second factor is that each player should strive for maximizing the number of gold coins he/she receives and the last is that each one prefers to eliminate the others if all other results would otherwise be equal [13].

2.5. Three-person ultimate game

There is also a wide recognition of bargaining situation with more than two players [14]. The three person ultimatum game (3P-UG) as an extended of standard game has been investigated by scholars in which the mutual behavior toward the proposer is affected by the presence of the third player. A three person ultimate game, consist of a proposer and two responders, both responders simultaneously decide whether to accept or reject the proposal. If both responders accept then all players’ earnings are according to the proposal but even if one of the responder (or both of them) rejects the proposal, all earns nothing. In an experiment designed by Knez and Camerer [15], the responders' strategies were investigated when the proposal made with asymmetric outside options, each responder is either not informed or informed about the proposal in the parallel ultimatum game. The results of experiment indicated that there were kind of “between-responder payoff comparison” [14], means that each responder varies his/her minimal acceptable amount based on the offer made to the other responder [15].

3. Factors studied

The reviewing of related articles, brought out a wide range of issues related to UG and its explanatory factors. We enumerate 15 different variables claimed to influence the results of the game. The following section presents these factors and also discusses their effects on the game.

3.1. Size of stakes

A reliable result in the literature was that the respondent's behavior is quite independent from size of the stake ([16-18]) but in the game designed by Anderson et al. [19], they find that sufficiently high stakes lead responder behavior to converge almost perfectly to full acceptance of low offers, even in the absence of learning effect. That study provides the first empirical support for the hypothesis of substantial stake effects in this game and provides insights into what might happen in higher stakes games.

3.2. Aging
It is also proven that age of the players can influence social-economic decision makings [20]. It is recognized that older adults are less impulsive, sensation seeking and risk tolerant than younger adults. Older adults were more likely to reject unfair divisions of money during an economic social-bargaining game and more likely to make equitable divisions of money during social giving game [21].

3.3. Impact of groups

In many economic theories humans are assumed as a rational, self-interested decision makers, who attempt to maximize its utility or economic profit [22]; many studies however, questioned these assumptions at least when examining decisions made by individuals. There is much debate as to whether these economic human premises are also problematic in a situation where individuals make a choice from the alternatives collectively which is known as group decision making [23]; for example Kugler et al [24] by reviewing the literature of collaborative decision making and comparing strategic behavior of groups and individuals in many games, found that that group decisions are relatively closer to the game-theoretic assumption of than individual decisions.

3.4. Information about features of the other player.

In a paper by Marchetti et al. [25], the impact of information about the proposer on the responder's decision is studied. In their research, four levels of description (information) were transferred between proposer and recipient which are (1) no information (control condition), (2) physical description including age, height, eye color, hair color, dress style, (3) brief positive psychological description (generous condition) and finally (4) brief negative psychological description (selfish condition). The results show that exchange of information affects the game. The achieved results are shown in Figure 2. As could be seen, the acceptance rate is significantly affected by both offer fairness as well as type of description provided of the proposer. The results indicates that the information about features of the players may generate the expectations about the outcome so it would causes violation of monetary self-interests [25].

3.5. Anonymousness effect

Current body of the literature also emphasis on the impact of "anonymity" on ultimatum bargaining e.g. [7, 26]. Among the most recent related researches, Lamba and Mace [27] designed an experiment in which the ultimatum game was played under three conditions as described below.

- A double-blind anonymous ultimatum game such that no one could link a decision to a participant, while they were made explicitly aware of this set-up prior to making their decisions. All participants made their
decisions in full privacy. This situation was called "Anonymous ultimatum game" in "anonymous context" (Condition AA; Completely Anonymous),

- Similar to the first situation except that the fact that all participants were seated in the same room and made their decisions independently, but in the presence and full view of all other participants. This situation was called "Anonymous ultimatum game" in "public context" (Condition AP; Anonymous in Public),

- Similar to the second situation by this difference that all decisions were made public knowledge once all participants had made their decisions, so that decisions could be linked to specific individuals. This situation is called "Public ultimatum game" in "Public context" (Condition PP; Completely Public).

The results show that proposer offers did not vary with changes in context (i.e., there was no “eyes effect”) but did vary with the degree of actual anonymity and the specific presence of known others. Responder behavior did not vary with changes in context, degree of actual anonymity or the specific presence of known others [27].

3.6. Impact of delay and waiting time

In different studies, it was proofed that delay or waiting time does not have any effect on the game and only amount of money plays an important role in acceptance or rejection of a proposal [28]. But in contrast, Grimm and Mengel [29] expressed delaying acceptance decisions in the ultimatum game drastically increases acceptance of low offers. In detail, in ordinary games at most 20% of low offers are accepted while by allowing responder to respond 10 minutes later, the acceptance rate of low offers changes to 60–80%. The achieved results are depicted in Fig 3.

![Acceptance rates with and without delay](source: Grimm and Mengel [29])

3.7. Impact of culture

Culture is known as one the economic variables that influence economic performance at the national level. Among the related papers, Chuah et al. [30] investigate the attitudes and experimental behavior of Malaysian and UK subjects in order to shed light on the nature of culture and the mechanisms by which it affects economic behavior. Also, Oosterbeek [31] find differences in behavior of responders (and not of proposers) across different geographical regions.

3.8. Impact of fairness

There is sufficient evidence that fairness considerations affect economic behavior in many environments [32]. It is investigated that in mutual gain bargaining situations anonymously players agree on rather equal outcomes. Also, it is proved that identical offers in an ordinary ultimatum game will decrease rejection rates by responder depending on the other available offers to the proposer [13]. It means that “a given offer with an unequal distribution of material payoffs is much more likely to be rejected if the proposer could have proposed a more equitable offer than if the proposer could have proposed only more unequal offers [32]”.

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3.9. Physical appearance

It was believed that physical appearance can influence the bargaining process in a number of situations. As an example, one can refer to Solnick and Schweitzer [33] that conduct an experiment to test the effect of physical attractiveness on ultimatum game decisions. Finding revealed no significant differences in the offers or demands has been made by attractive and unattractive people. However the treatment toward attractive people by others was different as they were offered more and more was demanded of them.

3.10. Geographical distribution

Reviewing the literature also reveals the increasing consideration of the impact of geographical differences on the expected outcomes of ultimatum game. As an instance, Kohler [34] assessed the level of social cohesion in some of the newly established communities in Zimbabwe by estimating average preferences for fairness in a structural model of bounded rationality. For this purpose, the ultimatum game was played by 234 randomly selected households in six traditional and 14 resettled villages almost two decades after resettlement. The achieved results show that in two out of three distinct resettlement schemes studied, the resettled villagers exhibit considerably higher degrees of fairness as well as rationality than those who live in traditional villages. Also, these findings are conforming to the idea of a raised need for cooperation required in recommencement [34].

In another research done by Boarini et al. [35], the experimental results of a “transcontinental ultimatum game” implemented between India and France was presented. The bargaining took the form of standard ultimatum games, but in one treatment Indian subjects made of offers to French subjects and, in another treatment vice versa. The findings show that French→Indian interactions usually ended up with unequal splits of money in favor of French, while nearly equal splits were the most frequent outcome in Indian→French bargaining.

3.11. Players experienced war

According to the study by Bellows and Miguel [36] conducted in Sierra Leone, people who experienced more violence during the civil war participate more in local collective action. These findings is also investigated and reported in ultimatum game (see [37]). Also, it is proved that more exposure to war will result in more sharing with neighbors in Burundi (see [38]) and more in-group inequality aversion in Georgia and Sierra Leone (see [39]).

3.12. Kinship and family effect

Reciprocity and kinship are two main predictors of philanthropy. In order to assess the effect of individuals’ family and kin relations on philanthropic behavior in ultimatum game, Macfarlan [40] conduct a research in a kin-based horticultural community in rural Dominica. Since different hypothesizes are examined in that research and different results are achieved, here that results are not discussed in detail and the interested readers are referred to the main paper.

3.13. Gender

Gender of both proposer and responder was predicted to affect the game. However, Kohler [41] does not find any evidence for gender-related differences in the Zimbabwean villagers’ preferences. Although the reported independency could be due to the small sample size, but that resettlement status affects the value villagers place on equality significantly.

3.14. Effect of schizophrenia
Schizophrenia is a severe mental disorder in which people interpret real situations abnormally and as a result have problems in thinking and have poor emotional response. It was assumed that this disorder would impair the patients’ bargaining ability. Interestingly, Agayet al. [42] found that patient who suffer from general schizophrenic did not completely exploit their strategic mental power as a “proposer” but their action as a "responder" did not significantly different from ordinary people.

3.15. Effect of masculinity

It has been debated that testosterone and masculinity will have apparent effect in many human behaviors such as financial risk preferences [43]. According to this discussion, Burnham [44] conducted a research in which the impact of testosterone on ultimatum game rejections was explored and the results clarified that high-testosterone men reject low ultimatum game offers.

4. Conclusion

The ultimatum game is an exemplar of how human behave against rational strategies suggested by game-theory and economic analysts. In the two-player UG (standard game), one plays as "proposer" and one plays as "responder". The proposer decides to divide a given amount of money between both players. If the responder accepts the proposal, then the proposal is implemented, otherwise both earn nothing. Although the expected sub-perfect Nash equilibrium of the game is when the proposer suggests small proportion (near to zero) to the responder and the responder accepts the proposal, in real situation this expectation do not happen and small offers are rejected by responders.

This game have different extensions such as dictator game, social ultimatum game, three-person ultimatum game, pirates game and trust game and on the other hand effect of different factors such as age, gender, culture, delay in response etc. in the game has been widely studied by different scientist start from 1982 till now. Since the observed results of this game in real situation could be utilized as the base for many economic and social theories, and also, to the best of our knowledge there were no comprehensive review over this game, in this review paper we provide the readers with concise review of the discussed game, its main extensions and studied factors from 40 selected papers published between 1982 to 2013 covering around 30 years time interval. This review could be a starting point for the interested readers who want to study different aspects of the ultimatum game in detail.

References