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The ultimatum game: raising the stakes

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Abstract

This paper examines the motivation of players in the ultimatum game when the stakes involved are significant sums of money. A questionnaire approach is used to elicit matched pairs of offers and minimum acceptances from respondents for games in which the stake size increases from $10 to $10,000. Only 16% of our sample could be said to have selfish preferences, the rest of the sample behaved as if they were concerned with relative payoffs. There was some evidence that the concern with relativities was not as strong in the large stake games. Despite this observation, for 60% of the sample, the offer expressed as a proportion of the stake did not change as the stake increased, and 28% of the sample would have offered and accepted half the stake in the $10,000 game.

JEL classification: C79; C91

1. Introduction and methods

In the ultimatum game, one player, the allocator, is directed to divide a sum of money (the stake) between him or herself and a second player, the recipient. If the recipient accepts the proposed division of the stake then both receive the amounts proposed by the allocator. If the recipient rejects the proposed division then both players receive nothing. The recipient knows the size of the stake, but the players do not know each other. The roles of allocator and recipient are typically determined by the toss of a coin.

Economists conventionally assume that individuals are rational and have selfish tastes. By rational we mean that they aim to maximise expected utility, and a player's tastes are selfish if they depend only on his or her payoff. The economists'

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assumption that rationality and selfish tastes prevail in human behaviour leads to the game theory prediction that the allocator should offer the smallest possible amount and that the recipient should accept this. This follows from backward induction: for the recipient any positive amount is better than zero and therefore should be accepted. The allocator knows this and so should make the smallest positive offer.

Thaler (1988) has reviewed the outcomes of experimental trials of the ultimatum game. A key feature of these results is that many of the allocators make offers which are half of the total stake, casting doubts as to whether the conventional specification of individual tastes is the correct one. Thaler argues that the prediction based on selfish tastes is falsified because the players are primarily motivated not by selfishness but by a concern for fairness.

The aim of this paper is to examine the motivation of players in the ultimatum game when the stakes involved are significant sums of money. In particular we are interested in whether individuals are motivated by a concern for fairness, or more generally with a concern for the relative payoff, in large stake games. In section 2, we outline the experimental procedures adopted. In section 3 we postulate a range of utility functions which may plausibly underlie the players' choices. We also determine the behavioural implications of these functions. In section 4 we present the results of our experiment and attempt to determine the proportions of our sample whose behaviour is consistent with each of the functions presented in section 3. In section 4 we also consider whether individuals become less concerned with relative payoffs if the stake size is increased. Our conclusions are presented in section 5.

2. The procedures

Rather than conducting direct trials of the ultimatum game we used a questionnaire which asked respondents how much they would offer as an allocator, and what minimum amount they would be prepared to accept as a recipient, for a stake of $10 where the minimum monetary unit that could be offered was $1 (hereafter referred to as Game 1). Respondents were also asked to state their offers and minimum acceptances for a stake of $10,000 where the minimum monetary unit was $1 (Game 2); and for their responses where the stake was $10,000, but the minimum amount that could be offered was $1,000 (Game 3). [1]

Clearly, given the amounts involved it was not possible, in contrast to the experiments referred to above, to provide monetary rewards to the participants of

[1] By keeping the minimum possible offer at $1, raising the stake has the effect of lowering the minimum possible offer as a proportion of the stake (Game 2). Game 3 reinstates the proportions of Game 1.

our study. However, we believe that the approach we adopted had some advantages over direct experiments with the ultimatum game. Firstly, it allowed us to conduct experiments in which respondents were asked to consider large prizes. Secondly, using a questionnaire allows us to consider respondent's offers and minimum acceptances as matched pairs, which has the potential to yield more information about the respondents' utility functions. Ortona (1991, pp. 325–326) provides other reasons why experiments in which the payoffs are hypothetical may be preferable to ones in which there are monetary payoffs.

The main criticism of our research methodology must be that our respondents had no incentive to report how they would actually behave. But equally, we have no reason to believe that they had any incentive to misrepresent their behaviour and, in so far as it is possible to compare, the responses we obtained using the questionnaire approach were similar to the results reported in experiments where the game is played with real prizes (Guth et al. 1982). Finally, there is evidence from other contexts that answers to hypothetical questions provide good indicators of behaviour, see for example Wardman (1988).

Our study differs from others in one further respect: our subjects are lawyers in private legal practice, whereas most previous studies have used student subjects. It is of interest to investigate whether other groups of individuals behave differently from students, however the main reason for choosing lawyers as our subjects was that the questionnaire involves the hypothetical disposition of large sums of money and we wanted to use subjects for whom such sums are commonplace. [2] An abridged form of the questionnaire used is given in an appendix to this paper. Questionnaires were mailed to the lawyers and forty three were returned. This represented a response rate of 60%.

3. Preference functions and their implications for behaviour

In this section we begin by presenting alternative preference functions which may be thought to motivate the respondents to our questionnaire. Four of these include a concern for the relativity of the payoffs. We have two specifications for this relativity term, in one specification the relativity term includes the ratio of the payoffs to the allocator and the recipient; in the other it is specified as the difference between the payoffs. We also distinguish between what we call envy and fairness. By our definition a person is envious if he or she prefers an allocation in which the relativity term is more favourable to him/herself. Some-

[2] The questionnaire was also used on a group of first year university economics students. While in broad terms the qualitative responses of the students were similar to the lawyers, there was evidence that the responses of the students were less thoughtful than those of the lawyers. Our explanation for this is that the students had difficulty envisaging the significance of the sums of money involved in the large stake games.

one who is concerned with fairness prefers a more equal allocation to a less equal one, regardless of who is favoured by the inequality. [3]

Our two alternative specifications for an envious individual are. [4]

$$U_i = U_i(P_i, P_i/P_j), \quad U_{i1} \geq 0, \quad U_{i2} > 0, \tag{1}$$

$$U_i = U_i(P_i, P_i - P_j), \quad U_{i1} \geq 0, \quad U_{i2} > 0, \tag{2}$$

and our two specifications for an individual concerned with fairness are:

$$U_i = U_i(P_i, P_i/P_j), \quad U_{i1} \geq 0, \quad U_{i2} > 0 \text{ if } P_i/P_j < 1,$$
$$U_{i2} = 0 \text{ if } P_i/P_j = 1, \quad U_{i2} < 0 \text{ if } P_i/P_j > 1 \tag{3}$$

$$U_i = U_i(P_i, P_i - P_j), \quad U_{i1} \geq 0, \quad U_{i2} > 0 \text{ if } P_i - P_j < 0,$$
$$U_{i2} = 0 \text{ if } P_i - P_j = 0, \quad U_{i2} < 0 \text{ if } P_i - P_j > 0 \tag{4}$$

Finally, for a selfish individual we have:

$$U_i = U_i(P_i), \quad U_{i1} > 0, \tag{5}$$

where P_i is the monetary payoff to the ith player and P_j is the monetary payoff to the jth player. If the recipient accepts the division of the stake proposed by the allocator then $P_i + P_j = S$, where S is the stake size. This means that equations [1] to [4] can also be expressed in terms of P_i and S. We now state the behavioural implications of these various utility functions. The proofs are not given as these are straightforward. [5]

Proposition 1. An individual who is selfish, that is whose preferences can be represented by equation [5], will accept the minimum possible offer in all three games.

Proposition 2. An individual whose tastes can be represented by any of equations [1] to [4] and who rejects the minimum possible offer in Game 3, will also reject it in Game 2.

[3] In equations [3] and [4], a fair allocation has been defined as one in which both the allocator and the recipient receive half the stake. We believe that this definition is appropriate in the current context. In other situations, an unequal division may be seen to be fair.

[4] To economise on the use of symbols $U_i()$ has been used to denote all of these different functions, this should not lead to any confusion in the subsequent discussion.

[5] For these proofs we make the reasonable assumption that the minimum acceptance for any individual will be less than, or equal to, half the stake. We also assume that for those equations including a term for the relative payoffs that this term is evaluated as being equal to 1 when the monetary payoff to both players is zero. The proofs of the propositions are available from the authors on request.

Proposition 3. An individual whose tastes can be represented by any of equations [1] to [4], and who rejects the minimum possible offer in Game 1, will also reject it in Game 2.

Proposition 4. If an individual's minimum acceptance expressed as a proportion of the stake falls, as S increases, then this is consistent with equations [1] to [4] if $U_{i1} > 0$.

Proposition 5. If an individual's minimum acceptance expressed as a proportion of the stake is constant, but not equal to half the stake, as S increases, then this is:
(a) Consistent with equations [1] and [3] if $U_{i1} = 0$.
(b) Consistent with equations [2] and [4] only by chance.

Proposition 6. If an individual's minimum acceptance is half of the stake for all S then this is consistent with equations [1] to [4] if $U_{i1} = 0$.

Proposition 7. If an individual's minimum acceptance expressed as a proportion of the stake rises, as S increases, then this is:
(a) Consistent with equations [2] and [4].
(b) Not consistent with equations [1] and [3].

4. Behaviour and the stake size

In this section we want to consider three questions. Firstly, can we say anything about the motivation of our sample by looking at their responses for the three games? Do their responses suggest that a concern with the relative payoff becomes less important as the stake increases? And if the answer to the second question is yes, is it possible to argue that for large stake games the assumption of selfish tastes is a defensible simplification for economists to make? We should stress that we do not expect that there will be an answer to these questions which will be true for all of our respondents: rather we expect to find a variety of motivations and

Table 1
Key summary statistics

	Game 1		Game 2		Game 3	
	Offers	Min. Accept.	Offers	Min. Accept.	Offers	Min. Accept.
Mean	4.3	3.6	3611.7	2599.0	3790.7	2883.7
Median	5.0	5.0	5000.0	3000.0	5000.0	3000.0
Mode	5.0	5.0	5000.0	5000.0	5000.0	1000.0
S.D.	1.5	1.8	1985.2	2137.1	1698.2	1815.4
C.V.	34.8	49.2	55.0	82.2	44.8	63.0

Table 2
Percentage of subjects who were prepared to accept the minimum possible offer

Game 1	29
Game 2	16
Game 3	44

responses to changes in the stake size. The key summary statistics for our questionnaire are given in Table 1.

The percentage of our sample that was prepared to accept the minimum possible offer in each of the three games is shown in Table 2. Sixteen per cent of the sample were prepared to accept the minimum possible offer in all three games. On the basis of Proposition 1, this is an estimate of the proportion of our sample who have selfish tastes. Excluding the individuals who accepted the minimum possible offer in all games, all other responses were consistent with Propositions 2 and 3. On this basis it is possible to argue that the utility functions of the respondents could be one of the equations numbered [1] to [4].

We now consider how the minimum acceptances expressed as a proportion of the stake vary if the stake size changes, but there is no change in the minimum possible offer. That is, we are comparing the minimum acceptances for Games 1 and 2. Table 1, shows that the mean minimum acceptance expressed as a proportion of the stake is lower in Game 2 than it is in Game 1. Excluding those individuals who accepted the minimum possible offer in both Games 1 and 2, 31% of our sample were prepared to accept an amount in Game 2 which was a smaller proportion of the stake than they were prepared to accept in Game 1. By Proposition 4 this behaviour is consistent with equations [1] to [4] if $U_{i1} > 0$. Thirty one per cent of the sample had a minimum acceptance of half the stake for both games. By Proposition 6 this is consistent with equations [1] to [4] if $U_{i1} = 0$. For those whose minimum acceptance was not half the stake, 14% had a minimum acceptance which was unchanged, as a proportion of the stake, over the two games. By proposition 5 this behaviour is consistent with equations [1] and [3] if $U_{i1} = 0$. Finally 7% of our sample increased their minimum acceptance as a proportion of the stake in Game 2 as compared with Game 1. By Proposition 7 this is consistent with equations [2] and [4]. That is, for those equations in which the relativity term is expressed as the difference between the two payoffs.

To summarise, 45% of the sample were concerned only with relative payoffs, 38% were concerned with both own and relative payoffs and only 16% are concerned only with own payoffs. And at least 7% of our sample were concerned with relative payoffs expressed as the *difference* between the payoffs.

Two comments can be made about these results. Firstly, it may seem surprising that such a large proportion of our sample was concerned only with relative payoffs, or that relative payoffs matter for such a large proportion of the sample. However this finding is consistent with the results reported by van de Stadt et al

(1985). Using panel data from the Netherlands and an entirely different approach to that adopted here, the authors report that:

> "*It turns out that the data are compatible with the hypothesis that utility is completely relative, but we cannot exclude the possibility that utility is partly relative and partly absolute.*"

Secondly, most papers that have considered utility functions which include a relativity term assume that this term should be specified as the ratio of the payoffs, for example see again van de Stadt et al. (1985). Our finding suggests that for a small proportion of individuals this specification does not capture their concern with relativity.

Thus far we have considered the minimum acceptances reported by the respondents, we now turn our attention to their reported offers. Trying to determine motivation from an analysis of the offers is problematic because the offer made by any allocator will depend not only on his or her utility function but also his or her beliefs as to the distribution of minimum acceptances. For example, a risk neutral individual who had selfish tastes and who knew the true distribution of minimum acceptances for our sample would make an offer of half the stake for all three of the games. But then so would an allocator whose utility function is given by equations [3] or [4] and for which $U_{i1} = 0$.

The mean offers presented as a proportion of the stake are smaller for the large stake games, see Table 1. In terms of the individual responses 7% of the sample offered a higher proportion of the stake in Game 2 than Game 1, 62% made an offer which was the same proportion of the stake, and 31% made an offer in Game 2 which was a lower proportion of the stake than offered in Game 1. Of those players which we identified as being selfish from their minimum acceptances, 43% kept their offer constant and 57% reduced their offer as a proportion of the stake. Sixty six per cent. of the non-selfish players did not change their offers expressed as proportions of the stake, 26% lowered them and 9% raised them as the stake increased.

It would appear that most of the respondents in stating their offers believed, correctly, that recipients do not require a larger proportion of the stake in the large stake game. It also seems plausible to argue that those allocators who reduce their offers as a proportion of the stake have a relativity term in their utility function which is of the envious rather than the fairness type.

So far we have examined the offers and minimum acceptances independently. We now want to consider them as pairs in order to see whether they can throw any further light on the motivation of the players. To do this we begin by identifying certain player types. We then consider the percentage of players who conform to these types in all three of the games. We define a strategy as a combination of a particular minimum acceptance with a particular offer.

For all of our games the strategy which maximises the expected monetary payoff is; offer half of the stake and accept the minimum monetary unit. An offer of half the stake is optimal if the money-maximising individual is risk neutral.

Table 3
Percentages of sample adopting selected strategies

Strategy	Game 1	Game 2	Game 3
Monetary maximising	14	7	16
Game theory	7	5	16
Fair division	43	28	28

Risk neutrality, in this context, is probably not crucial as it is plausible to assume that most allocators would believe that all recipients would accept half of the stake in all three games. The game theory strategy is defined as; offer and accept the minimum possible amount. The fair division strategy is; offer and accept half the stake. This last strategy would be optimal for an individual whose utility function was either equation [3] or [4] and for which $U_{i1} = 0$. The percentages of our sample that used these various strategies are given in Table 3.

The first feature worth noting is that the percentage of the sample whose behaviour would maximise the expected monetary payoff is similar for Games 1 and 3, but drops sharply in Game 2. Secondly, in Games 1 and 2 only a very small percentage of the players use the game theory strategy, but the percentage using it in Game 3 is substantially higher. Finally, the percentage of players who use the fair division strategy is much higher in Game 1 than Games 2 and 3.

Summarising this section then, we have found that only 16% of our sample can be said to have selfish preferences, the rest of the sample behave as if they were concerned with relative payoffs. However there is some evidence that the concern with relativities, for at least some of the respondents, is not as strong in the larger stake games. About one third of the sample were prepared to accept a smaller proportion of the stake in the larger stake games, and a similar proportion, largely the same individuals, made offers which were a smaller proportion of the stake in the larger stake games. Finally the proportion of the sample who played the fair division strategy dropped quite sharply in the large stake games. However, despite these observations it should be emphasised that for many of the respondents relativities remain important even in the large stake games. For 60% of the sample the offer expressed as a proportion of the stake was identical for all three games. The corresponding figure for acceptances is 44%. Furthermore, 28% of the sample continued to use the fair division strategy in Games 2 and 3. Our results then provide no support for the conventional assumption that selfish tastes are pervasive.

We now consider whether it is possible to interpret our data in a way which could attribute selfish tastes to a greater proportion of our sample. Firstly, we define an individual as almost selfish if his or her utility function is given by:

$$U_i = U_i(P_i) \text{ for } P_i/P_j > k, \tag{7}$$

Table 4
Perceptual errors required to be classified as "almost selfish". (The cumulative probabilities of the distribution of acceptances required to make an offer other than half the stake optimal, compared with the actual sample cumulative proportions).

Offer	Required probabilities	Sample proportions
$1000	0.56	0.44
$2000	0.63	0.47
$3000	0.71	0.53
$4000	0.83	0.67

where k is some constant and $0 < k < 1$. If this function is to rescue the selfishness assumption then k has to be reasonably close to zero. If we assume that $k < 1/9$, we can use the results from Game 3 to obtain an estimate of the number of almost selfish individuals. Equation [7] on its own does not lead to any major changes to our earlier conclusions as there was only 16% of the sample who played the monetary maximising strategy. However, if in addition we assume that all those who were prepared to accept the minimum possible offer in Game 3 were almost selfish and that those who did not also offer half the stake did so because they had an incorrect view of the distribution of minimum acceptances, then 44% of the sample can be classified as being either selfish or almost selfish.

Two comments can be made about this approach. Firstly, while it places the selfishness assumption in a more favourable light it does so by requiring that a large proportion of these individuals have a mistaken view of the distribution of minimum acceptances. Table 4 compares, for Game 3, the cumulative probabilities of the distribution of acceptances required to make an offer other than half the stake optimal with the actual sample cumulative proportions. This table is constructed assuming that the allocators believe that an offer of $5000 will be accepted for certainty. For example in Game 3 to believe that an offer of $3000 would maximise the expected monetary payoff requires the belief that the probability that $3000 or less will be accepted is 0.71, whereas the proportion of the sample that would accept $3000 or less is 0.53. Clearly the misperception involved is not trivial. The mean offer for those we have characterised as almost selfish is $1750, which compared to the monetary maximising offer of $5000, provides another indicator of the size of the perceptual errors involved. Rescuing the selfishness assumption then requires attributing large perceptual errors to the respondents. It is not possible to argue that a large proportion of the sample is both selfish and well informed.

The conclusion we have drawn is interesting if it is believed that it has some validity outside of the experimental context. We anticipate that some would think that it is hardly surprising that many of our sample respondents had an incorrect view of the distribution of acceptances. They were only exposed to the game once and so had no opportunity to learn, and that if they had played the game a number of times they would have come to hold more accurate beliefs. The argument may then continue by asserting that everyday interactions provide opportunities for individuals to learn from experience, so that the fact that many of the respondents are subject to misperceptions in our experiment says nothing about their perceptions in their normal lives. A final point may be that as misperceptions in their normal life will be costly it is reasonable to believe that people will eradicate them over time.

There are two reasons why we believe that this argument is not persuasive. Firstly, the argument rests on the belief that daily interactions are similar to repeated games, and with the implicit assumption that these interactions provide rapid feedback to the participants as to the appropriateness of their actions. Experiments which have been designed so that individuals do not obtain an immediate feedback suggest that individual behaviour is less likely to be optimal than if they do obtain such feedback, see for example Loomes (1991). Hence if it is believed that everyday interactions do not provide a quick, reliable feedback as to the effectiveness of action then it is at least plausible to argue that individuals who suffer from perceptual errors in our game are also likely to suffer from them in their everyday life. Some support for the idea that there are problems with assuming quick feedback can be obtained from writings in the philosophy of science. If scientists, who can conduct controlled experiments have difficulties because, in Quine's (1961) view, theories are underdetermined by the facts, then the problem is likely to be more acute in situations where it is not possible or very difficult to conduct controlled experiments.

Secondly, it is also possible to dispute the assertion that our respondents had no chance to learn. While they have never played the ultimatum game before they have had a large number of interactions with others, which should have allowed them to form a view as to how others may play the ultimatum game. One of our respondents in an informal conversation made the point that she would accept the minimum amount but that her experience led her to believe that others would not, and so she offered half of the stake in all of the games. We conclude then, that it is perfectly reasonable to extrapolate our findings to non-experimental situations.

There is evidence which suggests that selfishness and perceptual error may be related. Experimental trials of the prisoners' dilemma game have found that individuals who play the defect strategy are more likely to believe that their opponent will also play this strategy than is in fact the case, see Kelley and Staheski (1970). On the other hand players who use the cooperate strategy have a more realistic assessment of their opponents likely strategy.

5. Conclusions

We can summarise our results as follows. Firstly, this study replicates the findings of others, that individuals have a strong concern for relativity. This finding is particularly significant given that our respondents work in a strongly competitive environment. Secondly, our results suggest that for the sample as a whole this concern is less apparent in the large stake games. Thirdly, despite the second point, it still appears to be true that the relative payoff remains an important motivator for a significant proportion of our sample even in the large stake games. Fourthly, the selfish, well informed individual who inhabits so many economic models, only accounts for about 16% of our sample. The "almost selfish", but badly informed individual, may account for 28% of our sample. It could be argued that, at most, 44% of our sample have selfish tastes in Game 3. This is less than half the sample and hardly provides a strong justification for the pervasiveness of the conventional assumption.

It may be argued that concern with the relativity of the payoffs was an important motivator for many individuals in our sample because the sums involved were hypothetical, and that if the money were actual then a much higher proportion of the sample would have behaved selfishly. This argument may of course be true, but it has to be recognised that in the absence of supporting data such an argument is really just an assertion. The largest stake activity that most people engage in is earning a living. Solow (1990) argues that the labour market may not be like the economists' market for fresh fish, because the participants in the labour market have a concern for fairness and that this concern influences their behaviour. Thaler (1989) in the same vein argues that it is only possible to provide convincing explanations of interindustry wage differentials if we impute a concern for fairness to the market participants. Sutherland (1992) reports a case where one group of workers preferred a settlement that gave them less money but which preserved their relativity with another group. We regard this real world evidence as supporting our general view that relativities are an important motivator of human behaviour. We believe that many of the respondents in Game 3 remained motivated by a fair division of the stake not because the sums involved are hypothetical but because a concern for the relative outcome is far more pervasive than economists are generally prepared to recognise.

Appendix

Behavioural research questionnaire

This questionnaire is part of a research project being carried out by the Economics Group at Victoria University. Participation in the project by filling out this questionnaire is completely anonymous and voluntary. Thank you for your assistance.

Please read the following description of a situation involving two individuals

Person A is given a sum of money and is asked to divide it between herself and Person B. Person B knows how much money A has been given to divide, but they do not know each other, and the roles of Person A and Person B have been determined by the toss of a coin. A must make B an offer. B may either accept the offer, in which case she will receive the amount offered and A will get to keep the balance; or B can reject the offer, whereupon both receive nothing. Note that A can only make just one offer and this offer may not be withdrawn, and B may give just one answer. In other words, bargaining is not permitted.

Imagine that you are placed in the situation described in italics above. The amount of money is $10, in $1 coins. i.e. offers can be $0, $1, $2 and so on up to $10.

1. If you were Person A the amount you would offer is $____
2. If you were Person B the minimum amount you would accept is $____

Now imagine that the amount of money is $10,000 in $1 coins.

3. If you were Person A the amount you would offer is $____
4. If you were Person B the minimum amount you would accept is $____

Now imagine that the amount of money is still $10,000 but it is divisible only in amounts of $1,000 i.e Offers can only be $0, $1000, $2000 and so on up to $10,000.

5. If you were Person A the amount you would offer is $____
6. If you were Person B the minimum amount you would accept is $____

Thank you for your assistance

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