# Measuring inequity aversion in a heterogeneous population using experimental decisions and subjective probabilities

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*Published in:*
Econometrica

*Publication date:*
2008

# Measuring Inequity Aversion in a Heterogeneous Population using Experimental Decisions and Subjective Probabilities*

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February 13, 2008

**Abstract**

We combine choice data in the ultimatum game with the expectations of proposers elicited by subjective probability questions to estimate a structural model of decision making under uncertainty. The model, estimated using a large representative sample of subjects from the Dutch population, allows both non-linear preferences for equity and expectations to vary across socio-economic groups. Our results indicate that inequity aversion to one's own disadvantage is an increasing and concave function of the payoff difference. We also find considerable heterogeneity in the population. Young and highly educated subjects have lower aversion for inequity than other groups. Moreover, the model that uses subjective data on expectations generates much better in and out of sample predictions than a model which assumes that players have rational expectations.

**JEL** Codes: C93, D63, D84

**Keywords**: Ultimatum game, inequity aversion, subjective expectations.

*A previous version of this paper was circulated under the title "Actions and Beliefs: Estimating Distribution Based Preferences Using a Large Scale Experiment with Probability Questions on Expectations." We thank Vera Toepel and Marcel Das and his team at CentERdata for support throughout the experiment. We are also grateful for the comments from participants at the Princeton workshop in econometrics and experimental economics, the 2005 ESA North American Meeting in Tucson, the 2006 ESEM meeting in Vienna, seminar participants at Concordia University, Montréal, and Queens University, Kingston, three anonymous referees, and a co-editor. The first author thanks the Canada Chair of Research in the Economics of Social Policies and Human Resources for support. The second author thanks the Economic Science Laboratory at the University of Arizona for their kind hospitality.

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# 1 Introduction

Decision making under uncertainty plays an important role in economic theory and practice. Economic models of choice under uncertainty typically assume that agents combine their subjective probability distribution over uncertain outcomes with their preferences to choose the optimal alternative. Experiments of proposal and response have been used to understand the preference structure of decision makers. In such games, the proposers' payoffs not only depend on their own actions, but also on how responders will react, so that the proposers' decisions will generally also depend on their expectations about the responders' behavior.

This paper shows, with the specific example of the ultimatum game (Güth, Schmittberger and Schwarze, 1982), how the empirical content of experiments of proposal and response behavior can be improved in several ways. First, as discussed by Manski (2002), many experimental studies rely on assumptions regarding agents' expectations about other players' actions (such as rational expectations) to identify preferences, since observed choice data is generally not rich enough to uncover both expectations ('beliefs') and preferences. An exception is Nyarko and Schotter (2002), who collected data on actions and beliefs in a laboratory setting for repeated two player games with simultaneous decision making. They found that players are more likely to best-respond to their stated beliefs than to beliefs inferred by the analyst from past decisions. Following Nyarko and Schotter (2002) and Manski (2004), we address the identification problem by collecting data on proposers' subjective probability distributions over the actions of responders, in addition to the usual experimental data. Thus, we ask proposers direct questions on what they think are the probabilities that responders will make certain decisions.

A second distinctive feature of our work is a rich econometric model in which preferences and beliefs vary with ("observed") heterogeneity captured by observable background characteristics as well as "unobserved" heterogeneity not captured by the observed variables. Several papers provide point estimates of preference parameters, most of them based on experimental data collected in the lab with homogeneous samples (see, e.g., Goeree and Holt, 2000). We extend the existing literature by proposing a model that allows estimation of the entire distribution of preferences in a broad population. By using a large representative sample of the Dutch population rather than a convenience sample of students as used in much of the experimental literature, we follow the recent trend that has been established in the literature, e.g., Harrison, Lau, and Williams (2002).[1] This broad sample permits us to look into the issue of heterogeneity in preferences and beliefs.

Unlike other empirical choice models which incorporate subjective expectation data, our model also allows for correlation between preferences and beliefs of proposers. For example, we allow for the possibility that proposers with optimistic beliefs about the actions of responders also have systematically different preferences, leading to a spurious correlation between beliefs and actions and inducing an endogeneity bias in the estimates of the preference parameters. Avoiding this bias, we can make causal inferences on the effect of beliefs on choices.

Our application addresses preferences for inequity aversion, an issue that has received much attention in the recent experimental literature. Early research on social preferences using hypothetical questions suggests that non-linear asymmetric inequity aversion is prevalent in student populations (Loewenstein, Thompson, and Bazerman, 1989). Recent theories of inequity aversion have mostly focused on asymmetric linear inequity aversion (Fehr and Schmidt, 1999). Here, we use a model allowing for both non-linear and asymmetric inequity aversion, distinguishing aversion resulting from having a higher payoff from aversion that results from having a lower payoff than the other player. Our model nests the preferences introduced by Fehr and Schmidt (1999), which can explain the common finding in ultimatum game experiments that many proposers make equitable offers, in contrast to the traditional sub-game perfect equilibrium

[1]Other studies using representative samples are Bellemare and Kröger (2007), and Fehr, Fischbacher, Von Rosenbladt, Schupp, and Wagner (2002). They find that behavior in the investment game varies across sub-groups of the Dutch and German populations, respectively.

prediction that offers should not exceed the smallest positive amount that can be offered. The latter "traditional" prediction rests on two assumptions: proposers maximize their own expected monetary payoffs and expect responders not to reject any positive offer (for example, because proposers think responders also maximize their own monetary payoffs). Thus, both preferences that imply deviations from expected payoff maximization and the belief that not everyone accepts any positive offer may explain why experimental results are out of line with the traditional prediction. Our framework and the data on beliefs are particularly suited to disentangle these two explanations.

Our sample was randomly divided into four groups: proposers and responders in an ultimatum game and proposers and responders in a dictator game. The proposers in the ultimatum game were asked how much they wanted to offer the responder, and were also asked to state their subjective probabilities that other players would accept or reject any possible offer. Decisions of responders in the ultimatum game were elicited using the strategy method, asking responders to indicate their intended action for all possible offers that could be made. Proposers in the dictator game were asked how much they wanted to give to the other player, responders in this game had no active role. Our structural model estimates combined all the information on the proposers and responders in the ultimatum game. The proposer data in the dictator game were used to test the quality of out of sample predictions of this model.

Our results can be summarized as follows. First, we found substantial deviations between the average subjective acceptance probabilities reported by the proposers and the actual acceptance rates in the responder data. Second, like Nyarko and Schotter (2002), we found that the model which incorporates proposers' subjective probability distributions over the possible actions of responders fits the observed choice data better than a model which assumes that proposers have rational expectations. Third, we found substantial unobserved heterogeneity (i.e., heterogeneity in behavior and in expectations not attributable to observable characteristics) in the subjective probabilities as well as in preferences for inequity aversion, with a significant negative correlation between optimism in beliefs and inequity aversion to one's own disadvantage, suggesting that persons with high optimism have a lower disutility from having less. Fourth, we found that the subgroup of young subjects with a high education level and not participating in the labor market, has the most egoistic preferences in the sense that their predicted behavior in the experiment comes the closest to what is predicted by the traditional paradigm of maximizing one's own payoff. This suggests that inequity aversion is much larger in the Dutch population as a whole than extrapolations based on student samples would suggest. Fifth, we found significant evidence that inequity aversion to one's own disadvantage is an increasing and concave function of the payoff difference between players. Finally, we used the preference parameter estimates to construct out of sample predictions of behavior in the dictator game. The predicted distribution of choices is very close to the sample distribution of actual choices of proposers in the dictator game.

The rest of this paper is organized as follows. Our experimental design and procedure are introduced in section 2. Section 3 presents the empirical model. Section 4 describes the data. The estimation results of the structural model are discussed in section 5, where we also present simulations to assess the fit of the model and the role of heterogeneity, compare models with subjective and rational expectations, and present out of sample predictions. Section 6 concludes.

## 2 Experiment

Subjects are members of the CentERpanel, an Internet survey managed by CentERdata, consisting of about 2000 households who answer questions every weekend.[2] There are many reasons why the CentERpanel is an attractive medium to conduct experiments. First, it provides access to a representative sample of a population, which is one of the key features of our study. Second, the experiment was double blind as participants were

[2]For a description of the recruitment, sampling methods, and past usages of the CentERpanel see: www.centerdata.nl. Computer screens from the original experiment (in Dutch) with translations appear in the online appendix.

told that they would be anonymously matched and that their identities would not be revealed to the experimenters. Finally, CentERdata reimburses the costs for answering the questionnaire by crediting CentERpoints (hereafter CP; 100 CP = 1 Euro) to the respondents' bank accounts four times a year, allowing us to reimburse participants in a convenient way.

We randomly assigned CentERpanel members to the "ultimatum game" or the "dictator game." In both games, a proposer suggested to a responder a split of an amount of 1000 CP (10 Euros). We discretized the choice set of the proposer to eight allocations: $A \in \{(1000, 0), (850, 150), (700, 300), (550, 450), (450, 550), \ldots, (0, 1000)\}$, where the first and second amount denote the payoffs for the proposer and the responder, respectively. We ruled out the equal split $(500, 500)$ in order to force proposers to commit themselves to offering either more or less than the equal split, a feature which intuitively should help to increase the efficiency of our estimates.

In the dictator game, responders did not have an active role but had to accept the amount offered by the proposer. In the ultimatum game, on the other hand, responders could either accept or reject an offer. In our design, these decisions were elicited following the strategy method (Selten, 1967). Responders were asked whether they would accept or reject each of the eight allocations that could be offered. The response which corresponded to the actual decision of the proposer matched to this responder determined the payoff of both participants. The strategy method overcame the difficulty of having CentERpanel members interact in real time and provided more information, as responses to all eight possible allocations were elicited, including allocations that were never or hardly ever chosen by the actual proposers.[3]

After all participants had made their decisions, proposers and responders were ran-

[3]McLeish and Oxoby (2004) found that decisions in the ultimatum game collected with the strategy method were not statistically different from decisions made immediately after having received an offer. Brandts and Charness (2000) did not find significant differences of choices in simple sequential games between these two methods. On the other hand, such differences have been found for binary ultimatum games (Güth, Huck, and Müller, 2001) and sequential bargaining games with costly punishment (Brosig, Weiman, and Yang, 2003).

domly matched and payoffs were computed based on the decisions of each pair. Payoffs in the ultimatum game corresponded to the allocation chosen by the proposer if this allocation was accepted by the responder. If it was rejected, both participants received nothing. In the dictator game, players received the payoffs chosen by the proposer.

The beliefs of the proposers in the ultimatum game were elicited with a series of subjective probability questions. To simplify their task, subjects were asked how many out of 100 persons would accept each offer.[4] To be able to account for framing effects, proposers were randomly divided into groups that were asked for either their subjective *acceptance* or their subjective *rejection* probabilities for all offers. To avoid the possibility that belief elicitation influences behavior, these questions were asked after players had made their decisions. Subjects were not rewarded based on the accuracy of their expectations.[5]

The experiment was conducted in March 2004. Contacted individuals received an opening screen saying they were selected for an experiment carried out by a team of university researchers. A detailed description of the game and the payoff structure followed. Each person was informed that if participating, they would be randomly assigned to one of the roles and would be randomly matched to another panel member playing the opposite role. The role was revealed once a panel member had agreed to participate. We contacted 1410 panel members of whom 147 declined to participate. Of the 1263 panel members who completed the experiment, we had to exclude 40 people from the analysis because of missing information on some of their observable characteristics. In total, we analyzed the data of 377 (260) proposers and 335 (251) responders in the ultimatum (dictator) game.[6] As announced before the experiment, each participant

[4]This follows Hoffrage, Lindsey, Hertwig, and Gigerenzer (2000) who found that people are better at working with natural frequencies than with percent probabilities.

[5]Several studies have found that rewarding subjects for the accuracy of their expectations using an incentive compatible scoring rule does not produce significantly different elicited expectations; see Friedman and Massaro (1998) and Sonnemans and Offerman (2001).

[6]To balance the unequal numbers of players in both roles, some responders were randomly assigned twice to a proposer. As with all other participants, these responders received payments resulting from

received information on the outcome of the game and their final payoff two weeks after the experiment, and this amount was later credited to their bank account.

# 3 An Empirical Model of Preferences and Beliefs

In this section we introduce a structural econometric model to explain the behavior of proposers and responders in the ultimatum game, as well as the subjective acceptance probabilities reported by the proposers in this game. Proposer behavior in the dictator game was not used for estimation, but was used to evaluate the model's potential for out of sample predictions (see section 5). We allow for heterogeneity of both preferences and beliefs, which can vary with observed characteristics such as age, education level, labor force status, and gender (included in a vector $\overline{x}_i$) and with unobserved characteristics, not captured by variables in the data set. We also allow choices to vary with the person's role, since preferences may vary with someone's role in social interaction (Goeree and Holt, 2000, and Gächter and Riedel, 2005).[7] This enables us to investigate how preferences vary with background characteristics and to test whether preferences are role dependent.

## Flexible preferences with inequity aversion

We assume that subjects have preferences with possibly non-linear asymmetric inequity aversion. The utility of subject $i$ from payoffs $y_{self}$ to him-or herself and $y_{other}$ to the other player is given by:

$$\begin{aligned} v_i = y_{self} \quad &- \quad \alpha_{1i} \max\left\{y_{other} - y_{self}, 0\right\} - \alpha_{2i} \max\left\{y_{other} - y_{self}, 0\right\}^2 \\ &- \quad \beta_{1i} \max\left\{y_{self} - y_{other}, 0\right\} - \beta_{2i} \max\left\{y_{self} - y_{other}, 0\right\}^2 \qquad (1) \end{aligned}$$

only one pairing (the first). The online appendix provides a summary table of our experimental design.

[7] In an alternating offer bargaining experiment, Goeree and Holt (2000) found that proposers have a significantly higher disutility from having less than responders. In a two person bargaining experiment, Gächter and Riedel (2005) observed that the correlation of expectations about what fair divisions are and bargaining behavior varies between roles.

For subjects who only care about their own payoff, $\alpha_{1i}$, $\beta_{1i}$, $\alpha_{2i}$, and $\beta_{2i}$ would be zero. The linear inequity model of Fehr and Schmidt (1999) is a special case of equation (1), with $\alpha_{2i} = \beta_{2i} = 0$.[8]

We use the following specifications:

$$\begin{aligned} \alpha_{1i} &= \exp(\boldsymbol{x}_i'\boldsymbol{\alpha}_1 + u_i^\alpha), \quad (2) \\ \beta_{1i} &= \exp(\boldsymbol{x}_i'\boldsymbol{\beta}_1 + u_i^\beta), \quad (3) \\ \alpha_{2i} &= \widetilde{\boldsymbol{x}}_i\alpha_2, \\ \beta_{2i} &= \widetilde{\boldsymbol{x}}_i\beta_2 \end{aligned}$$

where $\widetilde{\boldsymbol{x}}_i = [1, \text{Responder}_i]'$ is a vector consisting of the intercept and a dummy "Responder$_i$" taking a value of 1 for responders and 0 for proposers. This vector is combined with a person's observable characteristics in the vector $\boldsymbol{x}_i = [\widetilde{\boldsymbol{x}}_i', \overline{\boldsymbol{x}}_i']'$.[9] The terms $u_i^\alpha$ and $u_i^\beta$ reflect unobserved heterogeneity, assumed to be independent of error terms and of $\boldsymbol{x}_i$ with a bivariate normal distribution with means zero and an arbitrary covariance matrix. We expected a positive correlation between $u_i^\alpha$ and $u_i^\beta$ since people with a general aversion to inequity might have large values for both.

As explained in section 2, each proposer had eight choices ($j = 1, \dots, 8$), involving their own payoffs $y_{self}(1), \dots, y_{self}(8)$. Proposers in the ultimatum game did not know whether their offer would be accepted. We assume expected utility maximization, where proposer $i$ uses his own subjective probability $Q_{ij}$ that offer $j$ is accepted. Since utility is zero if the offer is rejected, the expected utility of offer $j$ is given by $Q_{ij}v_{ij}$ where $v_{ij}$ denotes person $i$-s utility of payoffs $(y_{self}(j), y_{other}(j))$ (cf. equation (1)) with $y_{other}(j) = 1000 - y_{self}(j)$.

Perfect optimization would imply that proposer $i$ chooses the option $j$ that maximizes $Q_{ij}v_{ij}$. To allow for sub-optimal choices, we add idiosyncratic error terms $\lambda_i\epsilon_{ij}$

[8] In principle, it would also be possible to make $v_i$ nonlinear in $y_{self}$ or include interactions of $y_{self}$ and $y_{self} - y_{other}$. We did not pursue this and expect that it would be hard to obtain accurate parameter estimates, since the utility function is identified only up to a monotonic transformation.

[9] We also estimated the model with $\alpha_{2i}$ and $\beta_{2i}$ depending on the complete vector $\boldsymbol{x}_i$ but this gave no significant improvement in the likelihood. See footnote 18 below.

and assume that proposer $i$ chooses the option $j$ that maximizes $Q_{ij}v_{ij} + \lambda_i\epsilon_{ij}$. We assume that the errors $\epsilon_{ij}$ are independent of each other and of other variables in the model (i.e. $(u_i^\alpha, u_i^\beta)$ and $\boldsymbol{x}_i$), and that the difference of any two $\epsilon_{ij}$ across options follows a logistic distribution.

Responder $i$ has to trade off the utility of accepting or rejecting each offer $y_{resp}(j)$ $(j = 1, \ldots, 8)$. The utility of rejecting is zero, and the responder's utility $v_{ij}$ of accepting offer $j$ immediately follows from equations (1) and (2). A perfectly utility maximizing responder would thus accept offer $j$ if and only if $v_{ij} > 0$. Again, we assume that the responder accepts offer $j$ if $v_{ij} + \lambda_i\epsilon_{ij} > 0$, where $\lambda_i\epsilon_{ij}$ denotes idiosyncratic error terms which are assumed to follow a logistic distribution and to be independent across offers. The random effects $u_i^\alpha$ and $u_i^\beta$ lead to correlation between the choices of the same responder for different offers.

The size of the noise parameter $\lambda_i$ drives the likelihood of sub-optimal choice. We specify the noise parameter $\lambda_i$ as $\lambda_i = \exp(\boldsymbol{x}_i'\boldsymbol{\lambda})$, thus allowing the noise level to vary with background characteristics and role (since $\boldsymbol{x}_i$ also includes the role dummy).

## Beliefs

One way to incorporate beliefs in the model is to simply plug reported acceptance or rejection probabilities into the expected utility comparisons. This would have been justified if reported probabilities exactly equalled the probabilities that proposers use in making decisions, and were independent of errors and $(u_i^\alpha, u_i^\beta)$. In that case, the subjective probabilities $Q_{ij}$ are observed exogenous variables and the preference distribution could be estimated without modelling the beliefs.

This approach is not valid for two reasons. First, there appears to be a framing effect of asking either rejection or acceptance probabilities: the distribution of reported acceptance probabilities differed substantially from the distribution of acceptance probabilities implied by reported rejection probabilities (see next section). This framing effect cannot have affected the answers to the choice questions (since the "framed" questions on the beliefs were asked after the choices had been made), so that reported probabilities must first be purged of the framing bias before using them to construct the expected utilities in the choice model. Second, the acceptance probabilities may have been affected by unobserved factors that also drive the unobserved preference heterogeneity terms $u_i^\alpha$ and $u_i^\beta$. Early experiments in cognitive psychology (cf. Rapoport and Wallsten, 1972) already showed that subjective probabilities are correlated with utilities over outcomes. If acceptance probabilities are taken as exogenous in the choice model, this correlation would induce an endogeneity bias.

Both issues are dealt with by modelling preferences and acceptance probabilities jointly. We allow these probabilities to vary with the same individual characteristics $\overline{\boldsymbol{x}}_i$ as used for the preference parameters. Since (true as well as reported) probabilities may well be zero or one, we allow for censoring at 0 and 1, as in a two-limit tobit model. First, we model the true (unobserved) probabilities $Q_{ij}$ used in expected utility maximization, not affected by framing or other reporting errors:

$$\begin{aligned} Q_{ij}^* &= \overline{\boldsymbol{x}}_i'\delta + \gamma_j + u_i^P \\ Q_{ij} &= 0 \quad \text{if} \quad Q_{ij}^* < 0 \\ &= Q_{ij}^* \quad \text{if} \quad 0 < Q_{ij}^* < 1 \\ &= 1 \quad \text{if} \quad Q_{ij}^* > 1 \end{aligned}$$

The censoring guarantees that the true probabilities are between 0 and 1. The choice option effects $\gamma_j$ are expected to increase with $j$ for amounts below the equal split, since proposers probably realize that acceptance probabilities rise if the amount offered to the other player increases towards an equal split. Whether or not $\gamma_j$ also increases with $j$ beyond the equal split is not *a priori* clear, since acceptance probabilities and the beliefs about them can increase or decrease depending on the extent of inequity aversion. The unobserved heterogeneity term $u_i^P$ reflects the proposer's optimism. We assume that the joint distribution of $(u_i^\alpha, u_i^\beta, u_i^P)$ is 3-variate normal with mean zero and an arbitrary covariance matrix, independent of error terms and $\overline{\boldsymbol{x}}_i$.

Reported probabilities $P_{ij}$ can deviate from the true probabilities $Q_{ij}$ because of framing bias or an idiosyncratic reporting error $\epsilon_{ij}^P$. The latter is assumed to be i.i.d. normally distributed and independent of everything else. The framing bias at offer $j$ is modeled in a symmetric way, using a parameter $\phi_j$. We assume that a positively framed question induces a bias opposite to the bias of a negatively framed question and that the expectations used by proposers in making their decisions are in between. Therefore, we define a "framing" variable $F_i$ as 1 or -1 if belief questions are framed in terms of accepting and rejecting, respectively. The model for the "reported" acceptance probabilities $P_{ij}$ is as follows:

$$\begin{aligned} P_{ij}^* &= \overline{x}_i'\delta + \gamma_j + \phi_j F_i + u_i^P + \epsilon_{ij}^P \\ P_{ij} &= 0 \quad \text{if} \quad P_{ij}^* < 0 \\ &= P_{ij}^* \quad \text{if} \quad 0 < P_{ij}^* < 1 \\ &= 1 \quad \text{if} \quad P_{ij}^* > 1 \end{aligned}$$

The model for $P_{ij}$ is essentially a two-limit tobit model. The censoring guarantees that reported probabilities are between 0 and 1. Imposing symmetry on the framing effects is necessary to identify the framing parameters and the parameters $\gamma_j$ in the true probabilities from reported beliefs alone (i.e., without relying on the data on choices and assumptions on preferences).

# 4 Descriptive statistics

Table I describes the individual characteristics included in $\overline{x}_i$. About half of our participants were men. The median age in the sample was 48 years, with a range of 18 to 89. We used dummies for three age categories. Education level was captured by three dummies, comprising approximately the same numbers of participants. Similarly, we distinguished three income categories (based upon a categorical income question in the survey) and four categories of occupational status.

Figure 1 presents the distributions of amounts offered by proposers in the ultimatum and dictator games. These distributions exhibit two well-known features (see, e.g., Camerer, 2003): First, proposers sent positive amounts, with the mode around the equal split, and with very few amounts much above that. Second, the distribution of amounts offered to the other player in the ultimatum game stochastically dominated that in the dictator game. A chi-square test rejected the null hypothesis that both distributions were the same ($p$-value = 0.000).

Table II presents the choices of responders in the ultimatum game. Each line represents a choice sequence (obtained using the strategy method), with the frequencies in the final column. Choice sequences were grouped into two categories.[10] The biggest group (52.8%) was the group of "threshold players," who accepted any proposal above a certain amount. The second group (43.3%) was "plateau players," who accepted offers in a range excluding both the minimum and maximum amounts that could be offered. The width of the plateau is informative of the degree of inequity aversion to both one's own and the other player's disadvantage, as subjects rejected offers giving them either much lower or much higher amounts than the proposer. Plateau response behavior in the ultimatum game has been reported by Huck (1999), Güth, Schmidt and Sutter (2003), Tracer (2004), Bahry and Wilson (2006), and Hennig-Schmidt, Li and Yang (2008).[11] These studies indicated that broad subject pools and the presence of strong social norms are the most important reasons for non-monotonic response behavior.[12]

The sizeable fraction of plateau responders had an immediate consequence for the aggregate acceptance rates, presented at the bottom of Table II. The acceptance rates increased from 5% for low offers to above 90% for proposals around the equal split, but then declined to just above 55% when the complete amount was offered to the responder.

[10] A small (3.9%) group exhibited what we call inconsistent behavior, with no systematic response pattern. A table containing their responses appears in the online appendix. These responses were left out of the empirical analysis. Estimates of the model including them gave very similar results.

[11] Andreoni and Miller (2002) reported laboratory evidence of non-monotonic preferences in dictator games suggesting that people dislike even favorable inequity.

[12] In their video experiments, Hennig-Schmidt, Li, and Yang (2008) further found that moral concerns (e.g., losing face) and a perceived low probability of receiving high offers are other motivations for non-monotonic response behavior.

Figure 2 presents the means of the subjective acceptance probabilities for each offer separately for those who got the accept and the reject frames. Overall, proposers stated lower expected acceptance rates when asked in terms of acceptance than when asked in terms of rejection. This effect was smallest for amounts sent of 450 and 550 CP. We are not aware of studies that have found framing effects in expected behavior of others, although framing effects on expected *own* future decisions have been reported in several different contexts (Tversky and Kahneman, 1981, 1986; Meyerowitz and Chaiken, 1987). The widely documented fact that "losses loom larger than gains" may explain the framing effect we found (see, e.g., Thaler, 1991, and Kahneman and Tversky, 2000). From the point of view of proposers, the responders' utility gain of accepting (say) 150 CP may be perceived to be smaller than the responders' utility loss of rejecting 150 CP. This would be consistent with lower subjective acceptance probabilities in the acceptance frame relative to the rejection frame.[13]

Interestingly, many proposers in the ultimatum game anticipated the presence of plateau types in the responder population – the acceptance rates expected by proposers decline with offers in excess of an equal split. This result is all the more remarkable since proposers have not had a chance to learn the population pattern of response.[14]

# 5 Econometric results

We estimated the model in section 3 by maximum simulated likelihood.[15] To assess the impact of using the subjective probability distributions in the choice model, we estimated a second model assuming that proposers in the ultimatum game had rational expectations about the responders' acceptance rates. In that model, beliefs of all proposers were equal to observed aggregate acceptance rates of responders (cf. the bottom

[13]We thank Peter Wakker for the extensive discussion we had on this issue.

[14]Anticipation of non-monotonic response behavior has also been documented by Hennig-Schmidt, Li, and Yang (forthcoming) for proposers in ultimatum bargaining group experiments.

[15]Results were generated using Ox version 3.40 (Doornik, 2005). See the online appendix for details on the estimation procedure.

row of Table II). This model was estimated without the equation for beliefs.

## Model fit

Table III presents the distributions of observed and predicted offers for different age and education levels. For the complete sample (columns 1-2), our model successfully predicted both distributions. In particular, it correctly separated the probability mass of fair offers of 450 CP and 550 CP, and correctly predicted the decline in acceptance probabilities for very advantageous offers. Comparing the decisions of young (<35 years; columns 3-4) and old (>54 years; columns 5-6) individuals confirmed the quality of the fit. For example, it reproduced the large difference between both age groups' responses for offers above the equal split, with much more plateau behavior for the old than for the young. Similarly, the differences between high and low educated responders were quite well predicted.

## Out of sample predictions

Because our model was estimated using only data from decisions in the ultimatum game, we could use the model for out-of sample prediction of the offer distribution of proposers in the dictator game and compared them with the data in that game. Decisions in the dictator game were simulated using the model with the estimated preferences (estimated using only ultimatum game data), and setting acceptance probabilities to one. The last two columns of Table III present the actual and simulated distributions. The model correctly predicted the modal offer of 450 CP in the dictator game, although it under-estimated the corresponding frequency, while over-estimating the number of offers of 550 CP. Hence the model had some difficulties in allocating the exact probability mass between offers of 450 CP and 550 CP, but otherwise predicted dictator behavior quite well.

## Subjective vs. rational expectations

The usefulness of incorporating subjective probabilities is illustrated by comparing the results above with the fit obtained by the model assuming that proposers have rational expectations. The online appendix presents the fit of the latter model. Both models gave a similar fit of the acceptance probabilities of responders and of the offer distribution of older proposers in the ultimatum game. However, the model with rational expectations gave a substantially worse fit of the offer distribution of young proposers in the ultimatum game. In particular, it underpredicted offers of 450 CP and 550 CP by 7.5 and 5.5 percentage-points, respectively, and overpredicted offers of 150 CP by almost 11 percentage-points. The model using subjective expectations predicted this distribution much better. The two models also produced different (out-of sample) predictions of the offer distribution in the dictator game. While the model with subjective expectations predicted the shape of this distribution quite well, the model with rational expectations placed too large of a probability (67.1%) on offers of 0 CP, and almost no probability on offers of 450 CP. Hence, the model with subjective expectations fits and predicts substantially better than a model with rational expectations.

## Parameter estimates

Table IV presents parameter estimates of the model with subjective expectations.[16] We only discuss the main significant effects. The null hypothesis that individual characteristics affect $\alpha_{1i}$ and $\beta_{1i}$ in the same way was rejected ($\chi^2_{11} = 33.58$, $p$-value = 0.000). Surprisingly, there were hardly any significant effects of individual characteristics on inequity aversion to one's own disadvantage ($\alpha$); the only exception was that the retired were more inequity averse than others. More variables were significant in the equation for inequity at the other player's disadvantage ($\beta_{1i}$). Particularly, older respondents and those with less education were more inequity averse to the other player's disadvantage than younger and more highly educated subjects; higher income groups were less

[16]Estimates for the model imposing rational expectations are in the online appendix.

inequity averse than lower income subjects. We found no gender differences for disutility of having less and only weak differences for disutility of having more. This is in line with evidence from ultimatum games (e.g., Solnick, 2001) and dictator games (e.g., Bolten and Katok, 1995, and Andreoni and Vesterlund, 2001) using student subjects who did not know the gender of the other players.[17]

We found significant evidence of non-linear aversion to inequity to one's own disadvantage for both proposers and responders – the estimates of $\alpha_2$ are negative.[18] No nonlinearities in preferences were found for inequity aversion at the other player's disadvantage.[19] Interestingly, we found no significant evidence of non-linear aversion to inequity in the model imposing rational expectations (presented in the online appendix). Finally, role differences in the parameters $\alpha_1$, $\beta_1$, $\alpha_2$ and $\beta_2$ were jointly significant ($\chi^2_4 = 45.63$; p-value=0.000), implying that responders had a slightly stronger disutility for having less than proposers. This result might be due to the fact that preferences depend on opportunities and on self-serving notions of fairness.[20]

Figure 3 sketches the implied population distribution of inequity aversion to one's own and the other player's disadvantage. They are based on simulating disutilities for each difference between one's own and other player's payments for all subjects in the sample, accounting for observed and unobserved heterogeneity. Each graph presents the mean and the first and third quartiles of the corresponding simulated disutitilies. The disutility of having more than the other player is relatively homogeneous in the population and almost always positive and close to linear in $(y_{self} - y_{other})$. There is much more dispersion in the disutility of having less than the other player. In line with the negative estimates of $\alpha_2$, this disutility is a concave function of $(y_{other} - y_{self})$,

[17]Andreoni and Vesterlund (2001) found no significant differences in dictator giving between male and female students for experimental parameters which are comparable to our design.

[18]A likelihood ratio test did not reject the null hypothesis that $\alpha_2$ and $\beta_2$ do not depend on $\overline{x}_i$ ($\chi^2_{20} = 26.56$, $p$-value = 0.1481).

[19]The parameter $\beta_2$ for proposers and responders was jointly insignificant ($\chi^2_2 = 1.62$, $p$-value = 0.105); both non-linearity parameters for proposers and responders were jointly significant ($\chi^2_4 = 78.04$, $p$-value = 0.000).

[20]We thank an anonymous referee for pointing this out. See also Babcock and Loewenstein (1997).

and can be negative for a substantial group of subjects, particularly for high amounts offered.[21] This may reflect the fact that respondents were concerned about efficiency, making them more reluctant to reject any offer.[22] If efficiency is an additional motivation, then its effect would be captured by the inequity aversion parameters, possibly shifting down the predicted disutilities by a constant for all offers. Our experimental design does not allow us to separately identify this, however.

The estimates driving $\lambda_i$ suggest that male proposers made more errors than female proposers although the difference was significant only at the 10% level. Other differences between socioeconomic groups were insignificant, and we thus found no evidence that the extent to which participants' understanding of the game varies across socioeconomic groups.[23]

The effects of individual characteristics on beliefs were all insignificant. They were also jointly insignificant (Wald test statistic $\chi^2_{10} = 7.043$, $p$-value = 0.721). This result implies that expectations, i.e., the perception of the same uncertain situation, did not vary with background characteristics. As expected from the raw data, estimates of framing effect parameters $\phi_j$ were negative and significant except for proposals near the equal split.[24]

Finally, unobserved heterogeneity played a significant role, as shown by the positive and precisely estimated variances of $u_i^\alpha$, $u_i^\beta$ and $u_i^P$. The share of total unexplained variation in beliefs of proposers in the ultimatum game captured by individual attitudes was 35.7%.[25] As conjectured, $u_i^\alpha$ and $u_i^\beta$ were significantly positively correlated, indicating that individuals with a stronger dislike of inequity to their disadvantage also disliked inequity to their advantage. Interestingly, we found that the correlation of $u_i^P$

[21] Loewenstein, Thompson, and Bazerman (1989) also reported evidence suggesting that inequity aversion to one's own disadvantage is an increasing and concave function of the level of disadvantage.

[22] See Engelmann and Strobel (2004) for evidence on efficiency concerns in dictator games.

[23] A joint test did not reject the null hypothesis that $\lambda_i$ does not depend on $\overline{x}_i$ ($\chi^2_{10}$=11.79, $p$-value=0.299). We also estimated a model where $\lambda_i$ included interactions between the age and education variables. We found no significant improvement in the log-likelihood function ($\chi^2_4 = 4.86$, $p$-value = 0.302).

[24] They were also jointly significant: the Wald test gives $\chi^2_8 = 231.82$, $p$-value = 0.000.

[25] This share is $V\left(u_i^P\right)/(V\left(u_i^P\right) + V(\epsilon_{ij}^P))$.

with $u_i^{\alpha}$ was significant and negative, implying that proposers who are optimistic about the acceptance rates of responders had lower levels of inequity aversion to their own disadvantage.

### Predicted marginal disutility of inequity

The main qualitative implications of our model are graphed in Figure 4. The left graph plots three average predicted marginal disutilities from having less. The dashed line in each graph plots the predicted marginal disutility averaged over all players in the game.[26] We found that the predicted marginal disutility is positive but decreases with the payoff difference, reflecting that the level of inequity aversion is an increasing and concave function of the level of one's own disadvantage. The bold line presents the predicted marginal disutility averaged over subjects below 35 years of age with a high level of education. We found little difference with the predicted disutilities in the population. The dotted line presents the (constant) average marginal disutility calibrated by Fehr and Schmidt (1999) under the assumption that disutility to one's own disadvantage is linear in the payoff difference.[27] We found that the Fehr and Schmidt calibration is similar to our predictions for low, but not for high levels of inequity.

The right graph of Figure 4 plots the corresponding average predicted marginal disutility from having more than the other player. In line with our model estimates, we found that the average predicted marginal disutilities are approximately linear in the payoff difference, suggesting no significant non-linear relationship between inequity to other's disadvantage and the level of inequity. On the other hand, young and highly educated subjects had a significantly lower marginal disutility to other's disadvantage. Interestingly, their average predicted marginal disutility was very close to the average marginal disutility calibrated by Fehr and Schmidt (1999) mainly based upon studies

[26]The predicted marginal disutilities for player $i$ of having less and having more are $\widehat{\alpha}_{1i} + 2\widehat{\alpha}_{2i}(y_{other} - y_{self})$ and $\widehat{\beta}_{1i} + 2\widehat{\beta}_{2i}(y_{self} - y_{other})$, respectively.

[27]Their calibrated multinomial distributions for $\alpha$ and $\beta$ were: $\alpha \in \{0(0.3), 0.5(0.3), 1(0.3), 4(0.1)\}$ and $\beta \in \{0(0.3), 0.25(0.3), 0.6(0.4)\}$, where the numbers in parentheses denote the calibrated proportions.

with student subjects.

## Simulations

To better understand the interaction between preferences and expectations in sub-groups of the population, we used the estimates of the model with subjective expectations to predict the choice distributions for four groups of non-working men: below 35 years of age with either a university degree or high vocational training (group 1, close to a student sample), below 35 years of age with a primary or lower vocational degree (group 2), above 54 years of age with a university or higher vocational degree (group 3), and above 54 years of age with a primary or lower vocational degree (group 4).

Predicted offer distributions in the ultimatum and dictator games are presented in Figure 5. For dictators, beliefs were irrelevant and offers directly revealed underlying preferences. In line with the estimates, the young and educated dictator-proposers made the most selfish offers. The graphs reveal that age differences had a stronger effect on dictator offers than educational differences, in line with the parameter estimates. In the ultimatum game, offers not only reflected preferences but also beliefs. The model predicted that all four groups of proposers make predominantly "fair" offers, i.e., at the equal split. Thus, it seems that young and educated subjects made fair offers for strategic reasons, since lower offers had a smaller subjective probability of being accepted. On the other hand, older and less educated individuals made fair offers because of their preferences - they had large inequity aversion.

Figure 6 presents the predicted acceptance probabilities of responders in the ultimatum game. All subgroups had similar acceptance probabilities of offers below 550 CP, in line with the parameter estimates which revealed no significant age or education differences in $\alpha_{1i}$. Acceptance probabilities of offers above 550 CP reflected the differences in $\beta_{1i}$. The acceptance probabilities for young and highly educated responders remained above 80%, but were much smaller for older subjects. Again, differences were smaller across education levels than across age groups. Overall, the graphs predict that plateau behavior is a predominant response strategy for older and less educated subjects, while threshold behavior is common among the young and highly educated.

# 6 Conclusion

We combined data on decisions and beliefs to formulate a structural micro-econometric model separately identifying flexible preferences with non-linear inequity aversion and subjective expectations.

Our results indicated that the model which combined these data fits and predicts the decisions well and better than a model which assumes rational expectations, i.e., that proposers' beliefs were equal to the observed aggregate acceptance rates of responders. Contrary to the model with rational expectations, the model with subjective expectations also revealed a significant non-linear relationship between aversion to one's own disadvantage and the level of inequity. These results suggested that subjective probability data, although suffering from the problem of a substantial framing bias, can be useful to better predict and understand behavior in simple games of proposal and response.

Our data also revealed that a large number of responders rejected offers which give them more than the proposer, suggesting strong aversion to inequity at other's disadvantage. Interestingly, this non-monotonicity in responder behavior appeared to have been – qualitatively at least – anticipated by proposers in the game. We further found that a substantial part of the non-monotonicity in responder's behavior could be explained by important subject pool effects. Inequity aversion, in particular aversion to other's disadvantage, rises with age and falls with education level. Moreover, we found that young and highly educated participants represent one of the most selfish subgroups of the population under study. This suggests that care must be exerted before making population inferences based on convenience samples of students commonly used in laboratory experiments. It also implies that future research is warranted to explain these differences (for example, is the age effect a cohort effect or a true age effect?) and to verify them in other ways, such as actual behavior in society (giving to charity, volunteer work, etc.)

Our estimates imply that the average inequity aversion preferences of the young and highly educated were very similar to Fehr and Schmidt's calibrated distribution based upon lab experiments, although it seems that our sample made fewer zero offers than students in typical lab experiments. A thorough analysis comparing Internet experiments with "identical" lab experiments (see e.g., Bellemare and Kröger, 2007), also focusing on error rates and inconsistent choices, is left for future research. Another question that can be addressed in future research is whether experience with these kind of experiments reduces inconsistencies and plateau behavior.

Finally, it has been argued that the ultimatum game is not a proper environment to test specific models of fairness (see Andreoni, Castillo, and Petrie, 2003). While our focus has been on estimating extended Fehr and Schmidt (1999) preferences, our data could possibly be used to fit equally well other models of fairness proposed in the literature (e.g., Bolton and Ockenfels, 2000 and Cox, Friedman, and Gjerstad, 2007). Future research should aim to collect richer data, possibly by enlarging the choice sets available to players. Such data could then be used to formally test the Fehr and Schmidt model (or some other model) by extending the approach presented here. This would allow the determination of the most relevant preferences that characterize heterogeneity in behavior across a broad population.

Table I: Definitions and sample means of the explanatory variables

| | Mean | Description |
|---|---|---|
| Male | 0.547 | 1 if man, 0 if woman |
| Age $<$ 35 | 0.207 | 1 if below 35 years of age, 0 otherwise |
| Age 35-54 | 0.477 | 1 if between 35 and 54 years of age, 0 otherwise |
| Age $>$ 54 | 0.315 | 1 if above 54 years of age, 0 otherwise |
| Educ-low | 0.312 | 1 if primary education or low level vocational training, 0 otherwise |
| Educ-med | 0.344 | 1 if vocational training intermediate level or general secondary education, 0 otherwise |
| Educ-high | 0.343 | 1 if highest vocational training or university education, 0 otherwise |
| Income-low | 0.260 | 1 if net household monthly income less than 1000 euro, 0 otherwise |
| Income-med | 0.420 | 1 if net household monthly income between 1000 and 2500 euro, 0 otherwise |
| Income-high | 0.320 | 1 if net household monthly income more than 2500 euro, 0 otherwise |
| Market work | 0.586 | 1 if working for pay, 0 otherwise |
| House work | 0.125 | 1 if homemaker, 0 otherwise |
| Retired | 0.157 | 1 if retired from labor force, 0 otherwise |
| Other | 0.132 | 1 if other labor force status (e.g., student, unemployed), 0 otherwise |

Note: Sample of all players in the ultimatum and the dictator game.

Table II: Observed choice sequences for responders in the ultimatum game.

| 0 | 150 | 300 | 450 | 550 | 700 | 850 | 1000 | *N* |
|---|---|---|---|---|---|---|---|---|
| | | | | *Threshold behavior* (*N*=177) | | | | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 17 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 28 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 30 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 89 |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 12 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| | | | | *Plateau behavior* (*N*=145) | | | | |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 20 |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 22 |
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 61 |
| 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 6 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 8 |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 7 |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 2 |
| 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 4 |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 11 |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 1 |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| | | | | *Aggregate acceptance rates* | | | | |
| 0.05 | 0.15 | 0.32 | 0.93 | 0.91 | 0.68 | 0.58 | 0.55 | |

Note: The table columns present the acceptance decision (coded as 1 if accepted) for all 8 possible offers. *N* denotes the number of observations.
There were 335 responders in the ultimatum game. The responses of 13 participants who answered in an inconsistent way are omitted from the table.

Table III: Model fit of offer and response distributions for the model using subjective expectations.

| | All | | Low age | | High age | | Low education | | High education | | Dictators | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Proposers | Actual | Predicted | Actual | Predicted | Actual | Predicted | Actual | Predicted | Actual | Predicted | Actual | Predicted |
| 0 CP | 0.005 | 0.004 | 0.015 | 0.002 | 0 | 0.004 | 0 | 0.003 | 0.008 | 0.003 | 0.073 | 0.069 |
| 150 CP | 0.005 | 0.009 | 0.015 | 0.018 | 0 | 0.005 | 0 | 0.006 | 0 | 0.020 | 0.015 | 0.036 |
| 300 CP | 0.042 | 0.039 | 0.091 | 0.090 | 0.023 | 0.021 | 0.016 | 0.024 | 0.059 | 0.046 | 0.108 | 0.107 |
| 450 CP | 0.393 | 0.399 | 0.500 | 0.537 | 0.282 | 0.313 | 0.398 | 0.346 | 0.378 | 0.392 | 0.511 | 0.442 |
| 550 CP | 0.531 | 0.513 | 0.364 | 0.325 | 0.656 | 0.628 | 0.544 | 0.584 | 0.546 | 0.517 | 0.250 | 0.311 |
| 700 CP | 0.013 | 0.017 | 0 | 0.012 | 0.023 | 0.017 | 0.041 | 0.016 | 0 | 0.015 | 0.019 | 0.004 |
| 850 CP | 0.000 | 0.008 | 0 | 0.006 | 0 | 0.006 | 0 | 0.007 | 0 | 0.004 | 0.008 | 0.002 |
| 1000 CP | 0.011 | 0.009 | 0.015 | 0.007 | 0.015 | 0.005 | 0 | 0.01 | 0.008 | 0.002 | 0.015 | 0.026 |
| Sample size | 377 | | 66 | | 131 | | 123 | | 119 | | 268 | |
| Responders | | | | | | | | | | | | |
| 0 CP | 0.053 | 0.052 | 0.048 | 0.077 | 0.010 | 0.027 | 0.079 | 0.073 | 0.050 | 0.062 | | |
| 150 CP | 0.155 | 0.143 | 0.253 | 0.159 | 0.100 | 0.075 | 0.159 | 0.113 | 0.175 | 0.139 | | |
| 300 CP | 0.317 | 0.343 | 0.446 | 0.431 | 0.210 | 0.268 | 0.261 | 0.306 | 0.358 | 0.406 | | |
| 450 CP | 0.932 | 0.919 | 0.952 | 0.953 | 0.900 | 0.894 | 0.943 | 0.907 | 0.933 | 0.943 | | |
| 550 CP | 0.916 | 0.936 | 1.000 | 0.995 | 0.840 | 0.847 | 0.829 | 0.891 | 0.925 | 0.934 | | |
| 700 CP | 0.683 | 0.687 | 0.916 | 0.922 | 0.490 | 0.478 | 0.568 | 0.597 | 0.708 | 0.698 | | |
| 850 CP | 0.581 | 0.589 | 0.892 | 0.868 | 0.340 | 0.368 | 0.477 | 0.475 | 0.600 | 0.607 | | |
| 1000 CP | 0.549 | 0.555 | 0.867 | 0.845 | 0.310 | 0.329 | 0.443 | 0.411 | 0.567 | 0.571 | | |
| Sample size | 322 | | 83 | | 100 | | 88 | | 120 | | | |

Note: "All" refers to overall fit. "Low age" refers to subjects with less than 35 years of age, "high age" refers to subjects with above 54 years of age. "Low education" refers to subjects with either a primary of general secondary education. "High education" refers to individuals with either university training or high vocational training.

Table IV: Parameter estimates of the structural model with subjective expectations.

| | $\alpha_1$ | $\beta_1$ | $\lambda$ | $P$ | Offer | $\gamma$ | $\phi$ | Other parameters | |
|---|---|---|---|---|---|---|---|---|---|
| Constant | -1.584** | -0.635* | 3.009*** | | 0 CP | 0.107* | -0.160*** | $\boldsymbol{V}\left(\epsilon_{ij}^{P}\right)$ | 0.061** |
| | (0.681) | (0.367) | (0.458) | | | (0.055) | (0.022) | | (0.002) |
| Responders | 1.707** | 0.342 | 0.257 | | 150 CP | 0.311*** | -0.140*** | $\boldsymbol{V}\left(u_i^{\alpha}\right)$ | 0.716*** |
| | (0.656) | (0.309) | (0.199) | | | (0.057) | (0.031) | | (0.121) |
| Male | 0.014 | 0.172* | 0.405* | -0.003 | 300 CP | 0.419*** | -0.110** | $\boldsymbol{V}\left(u_i^{\beta}\right)$ | 0.806*** |
| | (0.142) | (0.104) | (0.223) | (0.028) | | (0.053) | (0.028) | | (0.206) |
| Educ-med | 0.054 | -0.323** | 0.159 | -0.033 | 450 CP | 0.543*** | -0.029 | $\boldsymbol{V}\left(u_i^{P}\right)$ | 0.034*** |
| | (0.146) | (0.113) | (0.272) | (0.029) | | (0.056) | (0.026) | | (0.004) |
| Educ-high | -0.234 | -0.265** | -0.027 | -0.013 | 550 CP | 0.588*** | -0.035 | $\boldsymbol{Corr}(u_i^{\alpha}, u_i^{\beta})$ | 0.245*** |
| | (0.145) | (0.125) | (0.323) | (0.032) | | (0.056) | (0.029) | | (0.048) |
| Age-med | 0.143 | 0.743*** | -0.169 | -0.028 | 700 CP | 0.490*** | -0.130** | $\boldsymbol{Corr}(u_i^{\alpha}, u_i^{P})$ | 0.921*** |
| | (0.148) | (0.157) | (0.258) | (0.037) | | (0.059) | (0.036) | | (0.103) |
| Age-high | 0.234 | 1.093*** | 0.420 | -0.071 | 850 CP | 0.440*** | -0.131*** | $\boldsymbol{Corr}(u_i^{\alpha}, u_i^{\beta})$ | -0.062 |
| | (0.200) | (0.205) | (0.370) | (0.046) | | (0.061) | (0.032) | | (0.182) |
| Income-med | -0.246 | -0.123 | -0.200 | 0.009 | 1000 CP | 0.339*** | -0.118*** | $\alpha_2^{proposers}$ | -0.515*** |
| | (0.221) | (0.164) | (0.300) | (0.034) | | (0.056) | (0.023) | | (0.082) |
| Income-high | -0.188 | -0.352** | -0.413 | 0.011 | | | | $\alpha_2^{responders}$ | -0.277** |
| | (0.261) | (0.178) | (0.285) | (0.040) | | | | | (0.123) |
| Paid work | 0.168 | 0.009 | 0.104 | 0.053 | | | | $\beta_2^{proposers}$ | 0.221 |
| | (0.193) | (0.146) | (0.274) | (0.039) | | | | | (0.184) |
| House work | -0.097 | -0.361* | -0.525 | 0.055 | | | | $\beta_2^{responders}$ | -0.289 |
| | (0.252) | (0.204) | (0.362) | (0.043) | | | | | (0.277) |
| Retired | 0.559** | 0.368* | -0.414 | 0.073 | | | | | |
| | (0.274) | (0.201) | (0.353) | (0.048) | | | | | |

Note: Standard errors in parentheses. *,**,***: significant at the 10%, 5%, and 1% level, respectively.

Figure 1: Distributions of amounts offered in the ultimatum game and the dictator game.

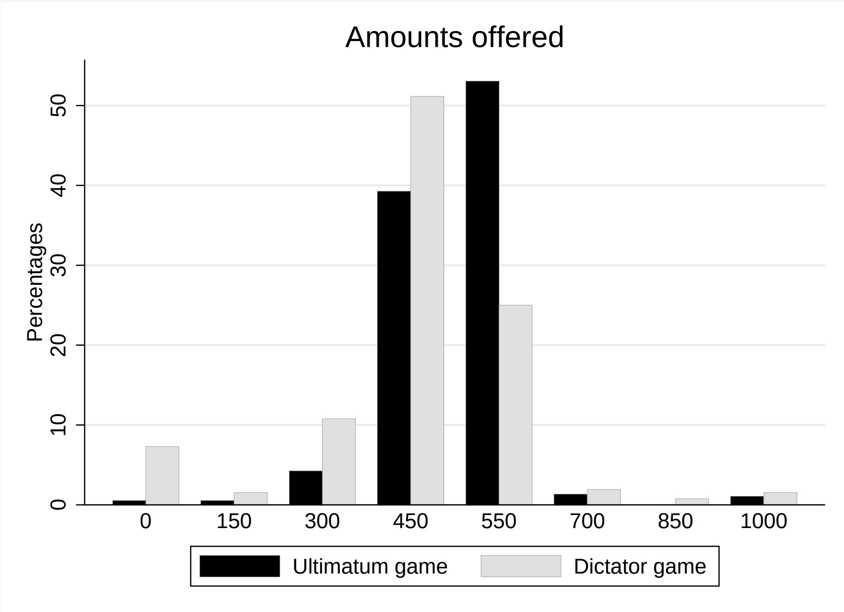



Figure 2: Proposers'anticipated acceptance probabilities in the ultimatum game collected using the acceptance and rejection framing.

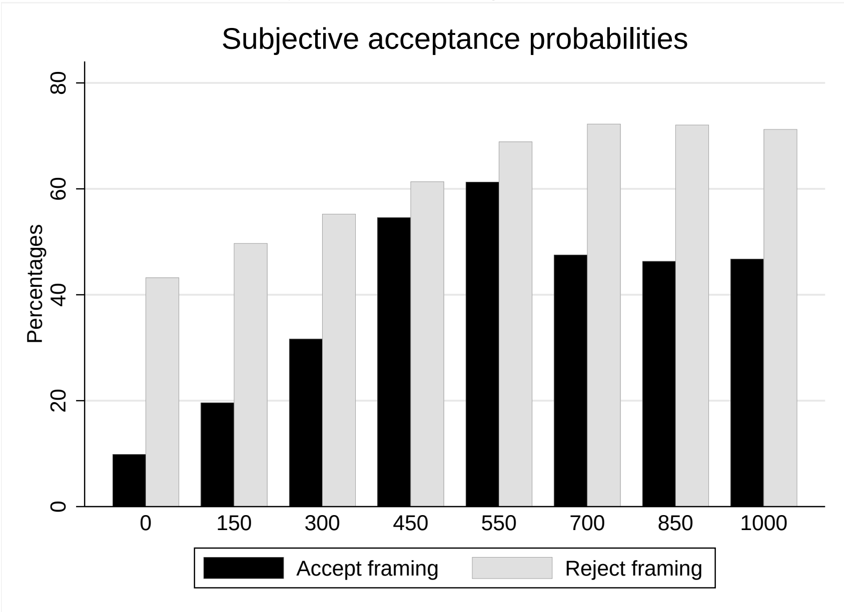
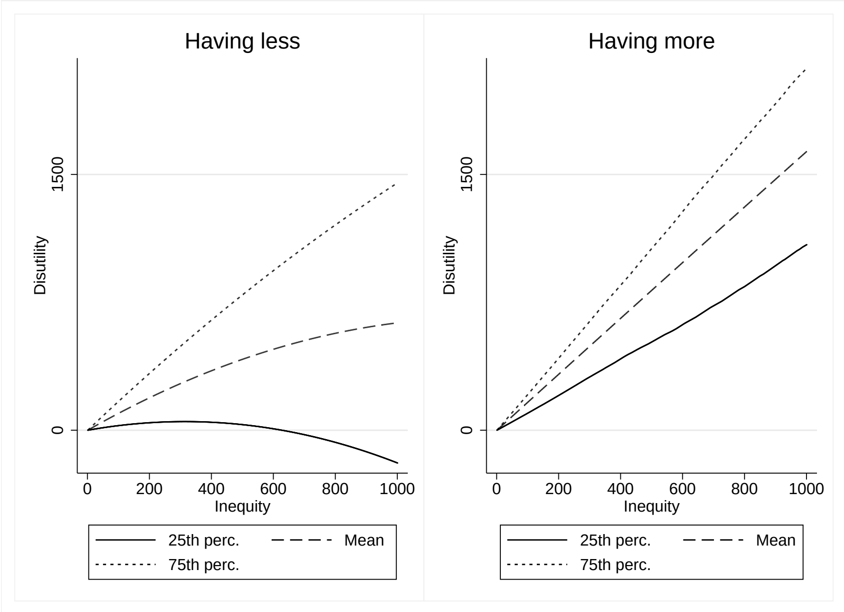
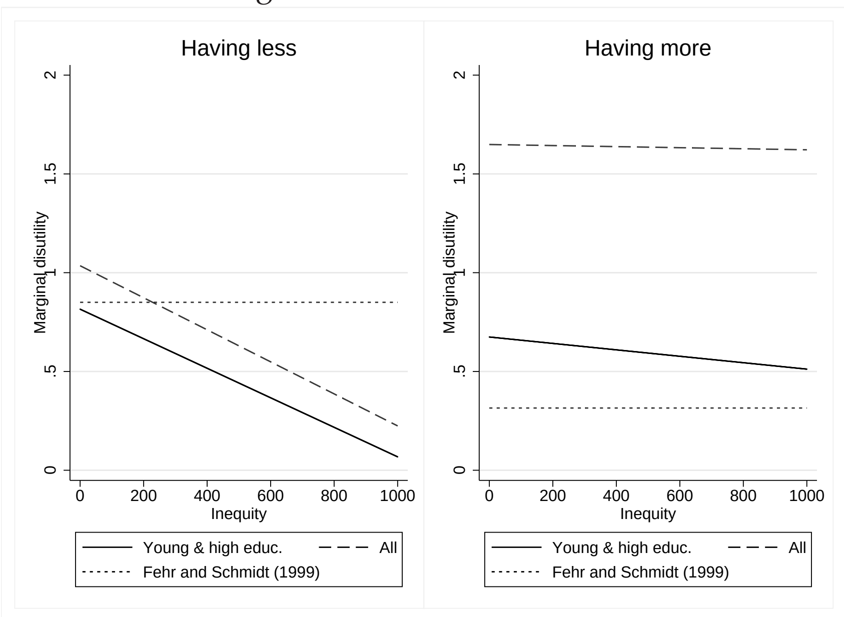


Figure 3: Predicted disutility based on the model estimates.



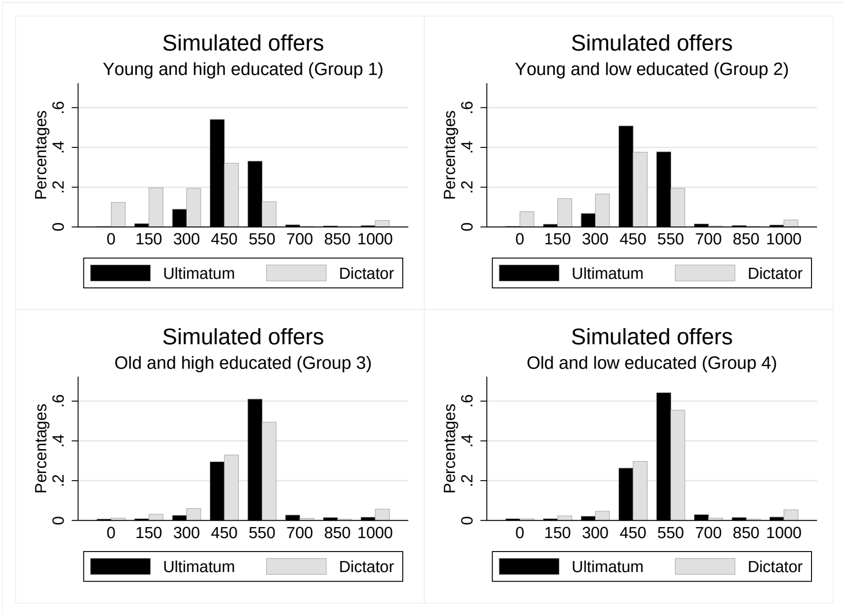

Note: Predicted average disutilities of having less (left) and of having more (right) for the whole population, 25th percentile, mean, and 75 percentile.

Figure 4: Predicted marginal disutilities based on the model estimates.



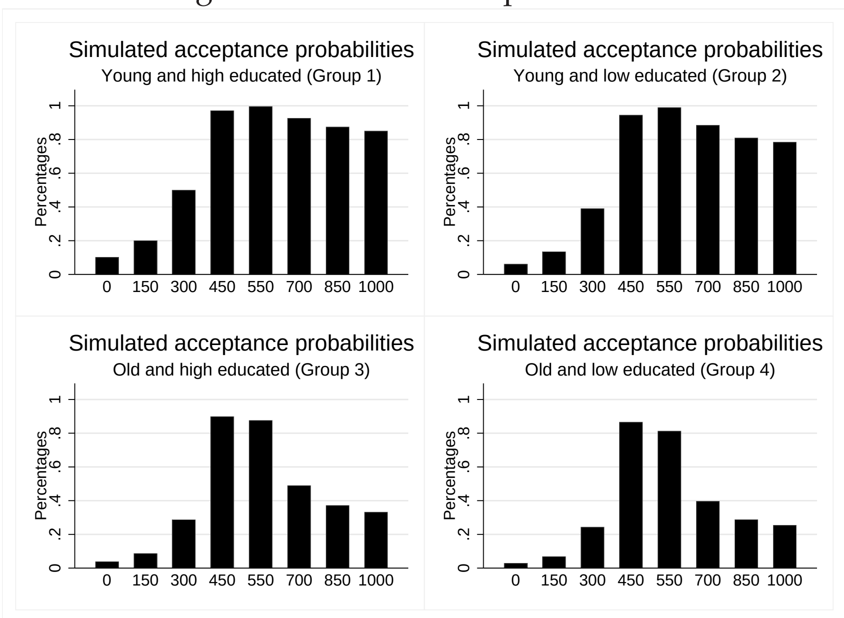

Note: Predicted average marginal disutilities of having less (left) and having more (right) for the whole population (dashed lines), only young [below 35 years of age] and high educated subjects (full lines), and Fehr and Schmidt (1999) predictions (dotted lines).

Figure 5: Predicted distributions of amounts offered.




Note: Predicted offers by proposers in the ultimatum and dictator game for four groups of non working men (group 1: <35 years, high; group 2: <35 years, low; group 3: >54 years, high; group 4: >54 years, low).

Figure 6: Predicted acceptance rates.




Note: Predicted acceptance rates of responders in the ultimatum game for four groups of non working men (group 1: <35 years, high; group 2: <35 years, low; group 3: >54 years, high; group 4: >54 years, low).

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