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by

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Blindfolded vs. Informed Ultimatum Bargaining—A Theoretical and Experimental Analysis

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Abstract

This paper analyzes blindfolded versus informed ultimatum bargaining where proposer and responder are both either uninformed or informed about the size of the pie. Analyzing the transition from one information setting to the other suggests that more information induces lower (higher) price offers and acceptance thresholds when the pie is small (large). While our experimental data confirm this transition effect, risk aversion leads to diverging results in blindfolded ultimatum bargaining due to task-independent strategies such as 'equal sharing' or the 'golden mean.' The probability of successful bargaining is lower in case of blindfolded than informed ultimatum bargaining.

Keywords: Ultimatum bargaining, information structure, experimental economics

JEL Classification: C91, D82

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1. Introduction

In ultimatum bargaining, proposer and responder can share an exogenously given monetary reward, the pie. The proposer makes a 'take it or leave it' offer to the responder who can accept or reject it. In the latter case, the pie is lost, otherwise it is distributed as proposed. In our setup the pie is a random surplus from bargaining. Both, the proposer and the responder, are either informed or not informed about the surplus. In the latter case, however, the distribution generating this value is commonly known.

When proposer and responder are both informed about the surplus from trade, they find themselves in the classical ultimatum bargaining situation, as originally analyzed by Güth et al. (1982). While being informed about the surplus from trade might be typical for many bargaining situations (e.g., when selling a well-established firm in a traditional industry), this becomes questionable in case of, e.g., selling a start-up firm in a newly developing industry. In the latter case, neither the potential buyer (proposer) nor the potential seller (responder) will know the surplus from trade with certainty. In our setup, we compare both situations: ultimatum bargaining between parties who both know the value of the surplus from trade (informed ultimatum bargaining) and ultimatum bargaining between players when neither party knows that value with certainty ('blindfolded' ultimatum bargaining). In a within-subject design, we do not only compare blindfolded and informed ultimatum bargaining but also analyze the effect of a transition from one to the other, i.e., we analyze what happens if buyer and seller become informed about the surplus from trade as, for instance, when an industry matures and information on the value of the traded firm becomes publicly available.

To the best of our knowledge, ultimatum bargaining among mutually uninformed players has not yet been studied. The same is true for the transition effect due to becoming informed in ultimatum bargaining between originally uninformed players. So far both, the theoretical and the experimental literature, have concentrated on *asymmetric* information settings where either the responder or the proposer is not informed about the size of the pie. Samuelson and Bazerman (1985), Mitzkewitz and Nagel (1993), Croson (1996), Rapoport and Sundali (1996), Chlass (2013) and Lee and Lau (2013) model ultimatum bargaining when only the proposer is informed. Likewise, previous experimental work by Ball et al. (1991), Foreman and Murnighan (1996), Harstad and Nagel (2004), Grosskopf et al. (2007), and Dittrich et al. (2012) focuses on a situation where only the responder is informed. Klempt and Pull (2012) and Güth et al. (2014) each analyze both cases of asymmetric information.

Furthermore, Güth et al. (2014) study the transition from either case of asymmetric information to one where both players are informed. Contributing to this strand of literature, we analyze a setting where both, proposer and responder, are not informed about the size of the pie, i.e., both are 'blindfolded,' and analyze the transition to a setting where both are informed.

We proceed as follows: section 2 introduces the theoretical model and derives hypotheses to be tested with the help of experimental data. The experimental design and setup are described in section 3. The main findings are illustrated and statistically analyzed in section 4. Section 5 concludes.

2. The theoretical model

The game involves proposer P, the potential buyer, and responder R, the potential seller.[1] The proposer valuates the commodity by $v \in (0, 1)$, and the responder valuates it by qv, where $q \in (0, 1)$ is exogenously given and commonly known. Thus both valuations are perfectly correlated. Due to $q < 1$, successful bargaining, i.e., trade, is always welfare enhancing. The proposer offers a price p for the commodity to the responder who then either accepts or rejects the offer. Defining $\delta(p) = 1(0)$ when the responder accepts (rejects) the offered price p, the gains from trade are $\delta(p)(v-p)$ for P and $\delta(p)(p-qv)$ for R. Total surplus thus amounts to $\delta(p)(1-q)v$, i.e., $(1-q)v$ is the size of the pie.

We distinguish two information settings, blindfolded ultimatum bargaining B (both players do not know the realization of the random variable v) and informed ultimatum bargaining I (both are informed about v) and assume the random variable v—determining the size of the pie—to be uniformly distributed on the unit interval (0, 1) what is commonly known.

Scenario *B*—blindfolded ultimatum bargaining: proposer P and responder R are not informed about the realization of value v but of its mean of 1/2.

The responder's expected payoff in case of $\delta(p) = 1$ is

$$E\pi_R(p) = p - q/2.$$

If risk neutral, the responder should accept ($\delta^*(p) = 1$) only if $p \geq q/2$.

[1] Specifically, we modify the 'acquiring-a-company' setting, introduced by Samuelson and Bazerman (1985), by not assuming the seller to be better informed than the buyer.

The proposer expects the payoff

$$E\pi_P(p) = 1/2 - p$$

in case of trade. If the proposer is risk neutral as well, his optimal offer is $p^B = q/2$. This implies a gain for the responder in case of $v < 1/2$, but a loss in case of $v > 1/2$. Given risk neutrality, the commodity will be traded, and the expected gains from trade for the proposer and the responder are

$$E\pi_P^B = (1-q)/2 \quad \text{and} \quad E\pi_R^B = 0\ .$$

Proposer P exploits ultimatum power and acquires the total expected surplus $(1-q)/2$ from trade. As benchmark predictions we will thus test

Hypothesis 1a. *In blindfolded ultimatum bargaining, the proposer offers price* $p^B = q/2$, *and*

Hypothesis 1b. *In blindfolded ultimatum bargaining, the responder only accepts price offers* $p^B \geq q/2$.

The second scenario maintains that v is randomly generated. However, the size of the pie is announced to proposer and responder before negotiating.

Scenario *I*—informed ultimatum bargaining: the realization of value v is commonly known when bargaining takes place.
Again the proposer exploits ultimatum power by offering price $p^I = qv$ which the responder accepts. The gains from trade

$$\pi_P^I = (1-q)/2 \quad \text{and} \quad \pi_R^I = 0$$

coincide with the expected gains from trade in scenario B: the proposer receives the whole surplus from trade, $(1-q)/2$, the payoff for the responder is 0.

Hypothesis 2a. *In informed ultimatum bargaining, the proposer offers price* $p^I(v) = qv$ *for all* $v \in (0, 1)$, *and*

Hypothesis 2b. *In informed ultimatum bargaining, the responder only accepts price offers* $p^I(v) \geq qv$.

The hypotheses stated so far further imply

Hypothesis 3. *In both scenarios (*B *and* I*) price offers and acceptance thresholds increase in* q. *In informed ultimatum bargaining (scenario* I*), price offers and acceptance thresholds increase (linearly) in* v.

Both scenarios, B and I, suggest that price offers are increasing in the level of q. In scenario I, value v determines the strength of the q-dependency: for $v > 1/2$ the price offered in scenario I increases more than in scenario B; for $v \leq 1/2$, however, the price offered in scenario B increases more. In case of $v \leq 1/2$, the optimal offer in scenario B is therefore higher than the one in scenario I, whereas in case of $v > 1/2$, the optimal offer is higher in scenario I. The same applies to responders' acceptance thresholds.

Hypothesis 5. *Becoming informed about v induces higher (lower) price offers and acceptance thresholds than in the blindfolded setting when $v > 1/2$ ($v \leq 1/2$).*

The expected surplus from trade is identical in both settings irrespective of information about v. From a cognitive perspective, however, blindfolded ultimatum bargaining seems more complex: knowing v, participants do not have to cope with risk, and the surplus from trade is less ambiguous. Therefore, one should expect successful bargaining to be more likely when value v, determining the size of the pie, is common knowledge. Since we experimentally implement the transition from uninformed to informed participants, we can specifically compare whether information about the size of the pie fosters successful bargaining as measured by the probability of acceptance $\delta(p)$.

Hypothesis 6. *Becoming informed about v increases the probability of successful ultimatum bargaining.*

Concerning risk attitude we expect that it affects behavior only in case of blindfolded ultimatum bargaining.

Hypothesis 7a. *Risk attitude should affect behavior only in blindfolded ultimatum bargaining (scenario* B*).*

Given our experimental framing of eliciting price offers and acceptance thresholds, predictions regarding the effect of risk attitude on price offers and acceptance thresholds are somewhat complex. In their seminal contribution Holt and Laury (2002) define risk aversion in the sense of trying to avoid negative expected payoffs. However, in our experimental setup of eliciting minimum selling and maximum buying prices the impact of risk attitude is not straightforward. While proposers increase the probability of successful bargaining by high price offers, such high price offers at the same time yield lower payoffs when bargaining is successful. Thus, risk attitude can have countervailing effects which partly overlap with loss aversion. Kachelmeier and Shehata (1992) point out that the elicitation of minimum selling prices induces a form of loss aversion which can lead risk-averse individuals to choose risk-neutral or risk-seeking (higher) acceptance thresholds. To disentangle both effects we distinguish the risk of (bargaining) failure from the risk of incurring losses: *failure-risk* averse subjects aim to render bargaining successful and *loss-risk* averse subjects aim to avoid negative payoffs. This distinction leads to the following hypotheses

Hypothesis 7b. *Failure-risk averse subjects choose higher price offers and lower acceptance thresholds.*

Hypothesis 7c. *Loss-risk averse subjects choose lower price offers and higher acceptance thresholds.*

In light of the strong experimental evidence highlighting the importance of behavioral motives in bargaining situations, we also add a prediction based on inequality aversion, namely that responders reject 'too low' price offers and proposers offer 'fairer' prices. One can justify the latter either by proposers anticipating responders' inequality aversion or by own intrinsic inequality aversion of proposers (see, e.g., Bolton and Ockenfels, 1998, 2000, and Fehr and Schmidt, 1999). Strong fairness concerns induced by inequality aversion lead to equal sharing, e.g., equal expected payoffs of proposer and responder. Thus, inequality aversion could lead participants to rely on a task-independent 'equal sharing' strategy which would render all price offers leading to unequal sharing of the pie as unfair. An alternative could be to reduce cognitive effort by simply choosing the midpoint of all possible values (i.e., the 'golden mean'), similar to 'level-0' behavior in guessing games (see Nagel, 1995). Either behavioral strategy could reflect an unwillingness to engage in more or less complex considerations regarding the experimental task(s). Additionally, in case of blindfolded ultimatum bargaining such task-independent strategies could simply be a response to lack of information providing possible guidance of what to choose. We therefore expect

Hypothesis 8. *Behavioral strategies such as 'equal sharing', due to inequality aversion, as well as the 'golden mean' strategy are especially relevant in blindfolded ultimatum bargaining.*

3. Experimental design and setup

Ultimatum bargaining is framed as an 'acquiring-a-company' game: a potential buyer (proposer P) offers a price p for a commodity owned by a potential seller (responder R), who chooses an acceptance threshold, i.e., we implemented the (monotonic) strategy method.[2] By asking responders for their acceptance thresholds instead of confronting them with only one specific proposer's price offer, we purposefully deviate from our theoretical model to gather more informative data allowing a more detailed analysis of responder behavior. Note, however, that the sequential-move equilibrium evolves as one out of a continuum of possible equilibria in the experimentally implemented simultaneous-move game. Participants were randomly assigned to one of the two roles and remained in that role. To study the transition from scenario B to scenario I in a within-subject design, we divided each session into two phases: In phase 1, participants played three rounds of scenario B, followed by three rounds of scenario I in phase 2.

The instructions for the first phase were handed out at the beginning of a session, the instructions for the second phase only after phase 1 had ended. Participants played six rounds altogether. In the three rounds of each phase, participants faced a random sequence of three different levels of q with $q = \{0.35, 0.45, 0.55\}$. They were informed about the $q-$level prior to choosing their price offer (acceptance threshold) in both scenarios where, in scenario B, value v was unknown (the level of q, however, was still common knowledge). Consequently, throughout the experiment knowing value v was equivalent to knowing the size of the pie. In phase 2, informed ultimatum bargaining, $P-$ and $R-$participants were successively confronted with 15 randomly drawn realizations of $v \in [0, 100]$ to observe how different pie sizes affect behavior. The realizations of v, including their order of appearance as well the order of the three $q-$levels, were randomly drawn before the experiment started and kept constant across all sessions.[3]

In phase 2, informed $P-$ and $R-$participants stated a price offer, respectively an acceptance threshold, in the range of 0 to 100 for every v: $P-$participants stated the price at which they would buy the commodity (buyer price BP), $R-$participants stated the minimum price for which they would sell the commodity, i.e., their acceptance threshold (seller price SP). If BP exceeded the seller's acceptance threshold SP, the commodity was sold at the offered price BP, i.e., $\delta(BP) = 1$, otherwise

[2] In a survey of experimental comparisons between the strategy and direct-response method, Brandts and Charness (2011) report differences in experimental results only for four out of nineteen experimental comparisons. All treatment effects found using the strategy method were also observed using the direct-response method.

[3] See the appendix for the instructions (appendix A) as well as the realizations of q and v in the experiment (appendix B).

bargaining failed, $\delta(BP) = 0$. The resulting payoffs, $\delta(BP)(v - BP)$ for the proposer and $\delta(BP)(BP - qv)$ for the responder, were described formally as well as verbally in the instructions.

In scenario I, played in phase 2 of the experiment, informed participants made altogether 45 decisions, corresponding to the 15 $v-$realizations in each of the three rounds. In scenario B, played in phase 1 of the experiment, participants were not informed about v; however, q was commonly announced. Participants made only one choice per round: uninformed $R-$participants stated their acceptance threshold, uninformed $P-$participants chose a price offer.

There was no feedback between rounds. At the end of the experiment, we randomly matched each $P-$participant with an $R-$participant and chose one $v-$ realization for each round as relevant for payment, i.e., participants were paid for altogether six decisions.

All sessions started with a set of control questions concerning decision tasks and payoffs. To emphasize that negative payoffs were possible, an appropriate example was included in the control questions. After all participants had answered all control questions correctly, three trial rounds including feedback to participants took place to ensure that they understood the consequences of their decisions. After the six rounds, participants were asked to fill out a postexperimental questionnaire.

Throughout the experiment, payoffs were calculated in Experimental Currency Units (ECU) and converted into euros at a given and known exchange rate (6 ECU = 1 euro). Besides a show-up fee of 5 euros, participants received their payoff earned according to six randomly drawn decisions (one from each of the 6 rounds) as well as the reward for a lottery question on risk tolerance (Holt and Laury, 2002) in the postexperimental questionnaire. The experiment was programmed in z-tree (Fischbacher, 2007). We ran three sessions, two with 32 and one with 30 participants. Participants were students of Friedrich Schiller University Jena (Germany). On average, sessions lasted about 90 minutes, and payments to participants amounted, on average, to 16.32 euros and ranged from 6.60 to 55.40 euros.

When payoffs (exclusive of participation fees and rewards for the lottery questions) summed up to a negative value, participants could choose to either pay their debt out of pocket or to work it off by completing an effort task (counting the letter 't' in a text). Of the 13 (13.8%) participants confronted with negative payoffs all chose to work off their debt.[4]

[4]For every correctly completed exercise, participants could work off 5 euros. A negative payoff

4. Experimental results

A first glimpse at our data suggests that blindfolded ultimatum bargaining leads to higher price offers and acceptance thresholds as compared to bargaining with complete information. Figure 1 depicts univariate kernel density estimations for both treatments, distinguishing between proposers choosing a price offer and responders choosing acceptance thresholds.[5]

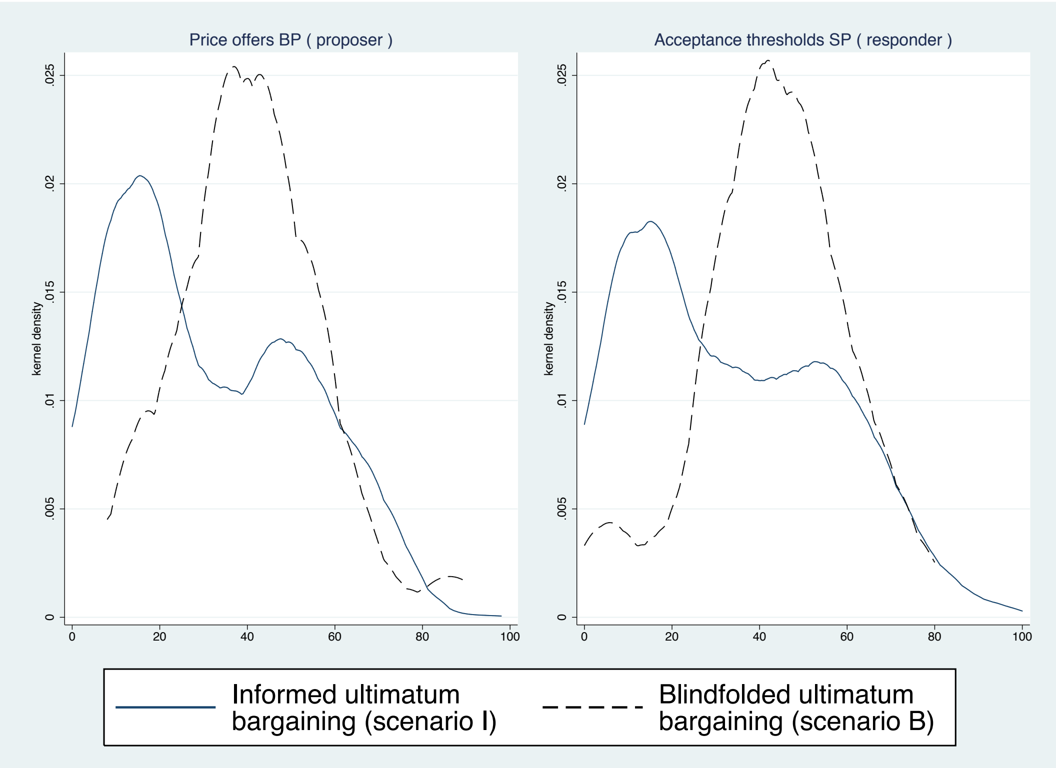

Figure 1: Price offers and acceptance thresholds in scenarios I and B

While we observe a single peak at the center of possible choices, 50, in the case of blindfolded decisions, price offers and acceptance thresholds both decrease and show a larger variance when participants become informed. As will be investigated in more detail below, this is caused by informed participants being more prone to implement task-specific strategies, therefore acting more sensitive to parameter q. Figure 2 depicts kernel density estimations separately for the three different

could not be compensated by the show-up fee or the reward for the lottery question in the postexperimental questionnaire. Consequently, if participants chose to work off their debt, they received a positive payoff consisting solely of the show-up fee and the reward for the lottery question.

[5] All presented kernel density estimations are carried out using the Epanechnikov kernel function with a bandwidth of 5.

$q-$levels. These simple descriptive results suggest that $q-$levels may indeed play a substantial role. Take, e.g., the highest $q-$level, 0.55: for informed and blindfolded ultimatum bargaining, the variance of price offers and acceptance thresholds increases relative to lower $q-$levels, where the effect is apparently larger for informed ultimatum bargaining.

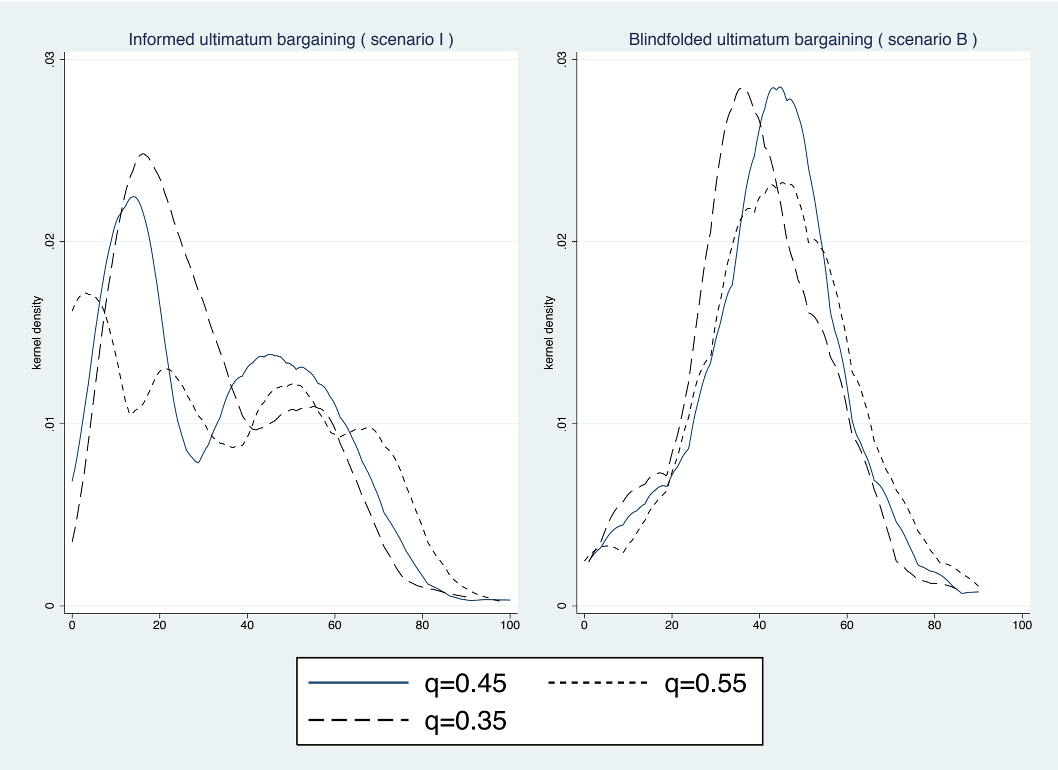

Figure 2: Price offers and acceptance thresholds for alternative $q-$levels

4.1. Bargaining for a random surplus from trade: Scenario B

To test Hypotheses 1a and 1b, we investigate whether decisions in blindfolded ultimatum bargaining are close to the theoretical benchmark.[6] After calculating optimal price offers and acceptance thresholds for every decision, we conduct Wilcoxon matched-pairs signed-rank tests to compare (hypothetical) optimal choices to actual ones. We find price offers on a 1% significance level higher than the benchmark for

[6] We do so by relying on generic predictions related to ϵ-equilibria (see Radner, 1980) tolerating deviations from benchmark payoffs yielding ε less than predicted by optimality. For an illustration, consider the benchmark solution for round 1 where $q = 0.55$. The optimal price offer would be $p^* = 27.5$, yielding a payoff of 22.5 for P. A 10% variation allows payoff reductions up to 2.25. This is fulfilled for $25.25 \leq p^\epsilon \leq 29.75$. As participants could only choose integer values, we considered the span from 25 up to 30 as being (nearly) optimal.

all levels of q, i.e., Hypothesis 1a predicting optimal price offers in scenario B is rejected.

Regarding responder behavior, Hypothesis 1b predicts that only sufficiently high offers should be accepted. Proceeding as before, we use a Wilcoxon matched-pairs signed-rank test which shows that acceptance thresholds are significantly higher than the benchmark for all levels of q (p-value< 0.01). Thus Hypothesis 1b is also rejected.

For all levels of q, the theoretical benchmark is not chosen frequently. The total frequency of near-optimal price offers and acceptance thresholds is 9 out of 87 in round 1 (corresponding to a share of 10.34%), 5 in round 2 (5.7%), and 7 in round 3 (8.0%). Potential behavioral explanations for the observed behavior might be 'equal sharing' and the 'golden mean.' Using expected payoffs, sharing equally requires price $p^e = (1+q)25$, whereas the 'golden mean' in our experimental setting is 50. Table 1 summarizes the respective predictions of equal sharing and golden mean together with the theoretical benchmark and the mean values of BP and SP in the experiment, distinguishing between the three possible (and throughout the experiment commonly known) levels of q.

$q-$level	0.35	0.45	0.55
Mean value BP	39.19	40.32	42.12
Mean value SP	39.02	44.30	45.15
Theoretical benchmark	17.50	22.50	27.50
Equal sharing	33.75	36.25	38.75
Golden mean	50.00	50.00	50.00

Table 1: Mean values BP, SP, theoretical benchmark, and values for alternative behavioral strategies in scenario B

Average choices in the blindfolded ultimatum game, BP and SP, lie between equal sharing and golden mean and—as reported earlier—exceed the theoretical benchmark solutions. Table 2 reports frequencies of decisions following either the benchmark, equal sharing, or the golden mean, allowing for a 10% deviation from the values reported in Table 1.

$q-$level	0.35	0.45	0.55
Theoretical benchmark	5.7	8.0	10.34
Equal sharing	18.4	12.6	23.0
Golden mean	21.8	39.1	27.6

Table 2: Relative frequencies (%) of alternative strategies in scenario B

Regarding Hypothesis 3, we estimate the impact of parameter q on price offers and acceptance thresholds. As $q-$levels were varied within subjects, we estimate a linear fixed effects model, thereby controlling for unobserved time-constant characteristics of individual subjects. Results are reported in Table 3.

	Price offers BP		Acceptance thresholds SP	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
q	14.634	(10.279)	30.652**	(13.446)
Constant	33.959***	(4.626)	29.033***	(6.051)
Observations	123		138	
R^2	0.022		0.085	

Significance levels : * 10% ** 5% *** 1%

Robust standard errors

Table 3: Effect of $q-$level on price offers and acceptance thresholds in scenario B (fixed effects)

Estimation results suggest that the $q-$level has a significantly positive effect only on acceptance thresholds SP, whereas there is no significant correlation between q and price offers BP. Recall that the (ex post) gains from trade are $v - BP$ for the proposer and $BP-qv$ for the responder. The result that only responder decisions are affected by different $q-$levels suggests that participants base their decisions mainly on their own payoffs: responders increase acceptance thresholds with $q-$levels to ensure a positive payoff, whereas proposers—given that their (ex post) payoffs do not directly depend on q—are not significantly affected by changes in q. Participants apparently often neglect how q affects the strategy of their bargaining partner. In the case at hand proposers do not account for the fact that responders increase acceptance thresholds in response to higher $q-$levels. In summary, these results suggest

Result 1. *In blindfolded ultimatum bargaining, proposer and responder behavior deviates from the benchmark in that proposers offer higher than optimal prices and* *responders choose higher than optimal acceptance thresholds. While—as predicted—acceptance thresholds increase in $q-$levels, price offers are not significantly affected by q.*

Regarding risk attitude, Hypothesis 7a predicts that it should affect behavior only in blindfolded ultimatum bargaining, with Hypotheses 7b and 7c further specifying the expected effect. To test whether subjects' (constant) risk attitudes significantly affect price offers and acceptance thresholds, we estimate an ordinary least squares (OLS) model, clustering standard errors at the subject level. To measure risk attitude, we use the postexperimental lottery question and follow the instrumentalization of risk aversion proposed by Holt and Laury (2002). To allow for the analysis of possible interaction effects of risk aversion with the participants' role (proposer or responder) and with responders' valuation q we construct a dummy variable $RISK$, taking unit value if participants are risk averse, i.e., if they chose a relatively 'safer' option more often than a risk neutral subject would have.[7] We further include the dummy variable $PROP$, taking unit value when a participant is in the role of a proposer and zero value when a participant is in the role of a responder. By this we analyze the distinct effect of risk attitude on proposers and responders. When analyzing the joint effect of responders' valuation and risk aversion (interaction term $RISK^{*}PROP$ in regression model II) we use $q-$level 0.35 as reference category. Finally, we control for gender effects by including the dummy variable $FEMALE$. Table 4 reports our results.

Regression model I in Table 4 suggests that risk aversion does not affect behavior in blindfolded ultimatum bargaining. However, including interaction effects of risk aversion and being a proposer as well as risk aversion and the different $q-$levels (regression model II) reveals that risk attitude does affect behavior: we find a significantly negative effect for the $RISK$ dummy and significantly positive effects for its interaction terms with high $q-$levels. While being a proposer, $PROP$, generally leads to a significantly lower choice, the insignificant effect of interaction term $RISK^{*}PROP$ reveals that there is no role-specific effect of risk attitude. The overall negative effect of risk attitude suggests that responders' choices are driven by 'failure-risk aversion' leading them to choose lower acceptance thresholds and proposers' choices by 'loss-risk aversion' leading them to choose lower

[7] Given the setup of Holt and Laury, 2002, this is the case if the safe option is chosen in more than four out of ten possible choices. We observed non-monotonic risk preferences for seven out of our 94 participants and dropped these observations.

	(I)		(II)	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
q	2.310***	(0.863)	-7.170	(5.254)
$q = 0.45$			-2.667	(2.707)
$q = 0.55$			-2.000	(2.223)
$RISK$	2.846	(3.325)	-7.774**	(3.557)
$PROP$	-1.625	(3.215)	-8.815**	(3.791)
$RISK^{*}q = 0.45$			6.947**	(3.094)
$RISK^{*}q = 0.55$			7.680**	(2.963)
$RISK^{*}PROP$			8.096	(5.203)
$FEMALE$	-1.982	(3.079)	-2.122	(3.081)
Constant	36.536***	(3.844)	48.152***	(2.785)
Observations	261		261	
R^2	0.023		0.034	

Significance levels : ∗ 10% ∗∗ 5% ∗ ∗ ∗ 1%

Standard errors clustered at subject level

Table 4: Effect of risk aversion in scenario B (OLS)

price offers. However, the positive effect of the interaction terms $RISK^{*}q = 0.45$ and $RISK^{*}q = 0.55$ suggests that for high stakes these effects are reversed: now 'failure-risk aversion' prevails for proposers leading them to choose higher price offers, whereas 'loss-risk aversion' prevails for responders leading them to choose higher acceptance thresholds.

In summary this supports Hypothesis 7a that risk attitude affects decisions in blindfolded ultimatum bargaining: generally, risk aversion leads to lower prices, whereas high responder valuations q induce a positive effect: if stakes are high, responders want to make sure they gain from selling whereas proposers try to assure that bargaining is successful. We state

Result 2. *Risk aversion leads to lower price offers and acceptance thresholds, with the effect being reversed if responders' valuation parameter q is high.*

4.2. Bargaining for a known surplus from trade: Scenario I

In scenario I, proposer and responder can condition their decisions on value v. To investigate Hypothesis 2a, predicting exploitative price offers in scenario I, we check whether actual and predicted choices are significantly different from each other. To this end, we calculate standard deviations between actual and optimal choices at the subject level, thereby averaging across the different choices made for each of the 15 randomly selected v-values. In a next step, we compare these standard deviations to the theoretically predicted deviations, namely zero, using Wilcoxon signed ranks tests. For both, proposers and responders, deviations from the benchmark are significant at the 1% level, thus rejecting Hypothesis 2a and Hypothesis 2b.[8]

Result 3. *In scenario I, proposer and responder behavior deviates from the theoretical benchmark in that proposers offer higher than optimal prices and responders set higher than optimal acceptance thresholds.*

Table 5 summarizes the mean values of BP and SP in the informed ultimatum game (scenario I). Here average choices lie between the theoretical benchmark and equal sharing.

$q-$level	0.35	0.45	0.55
Mean value BP	30.61	30.95	32.04
Mean value SP	31.23	34.18	34.60
Theoretical benchmark	17.50	22.50	27.50
Equal sharing	33.75	36.25	38.75
Golden mean	50.00	50.00	50.00

Table 5: Mean values BP, SP, theoretical benchmark, and values for alternative behavioral strategies in scenario I

In Table 6 we report relative frequencies of decisions lying within a 10% range of either the benchmark, equal sharing, or the golden mean.

Experimentally, the ultimatum game has been found to present an especially dif-

$q-$level	0.35	0.45	0.55
Theoretical benchmark	20.8	5.7	8.4
Equal sharing	8.0	7.6	6.8
Golden mean	12.9	16.8	16.9

Table 6: Relative frequencies (%) of alternative strategies in scenario I

[8]Proceeding similarly to scenario B conducting Wilcoxon matched-pair signed-rank tests to compare (hypothetical) optimal choices to actual ones we find price offers as well as acceptance thresholds are on a 1% significance level higher than the benchmark for all levels of q.

ficult environment for learning subgame perfection (see Andreoni and Blanchard, 2006), i.e., for learning to choose a low price offer and a low acceptance threshold as predicted by game theory. In our experiment we observe the frequency with which the benchmark strategy is chosen in the informed ultimatum game to increase to 20.8% in the final round. Since we held the order of v values and $q-$levels constant across sessions (0.45 in round 1, 0.55 in round 2, and 0.35 in round 3 of scenario I), we cannot exclude that this increase is also caused by learning. However, earlier findings by Andreoni and Blanchard (2006) as well as further experimental evidence point to a convergence of ultimatum bargaining over successive rounds towards the equal split rather than towards the theoretical prediction (see, e.g., Nowak et al., 2000). We therefore conjecture that our results most likely do not result from learning effects.

As for blindfolded ultimatum bargaining, regarding Hypothesis 3 we estimate a linear fixed effects model to investigate the impact of parameter q and additionally of v on price offers and acceptance thresholds. Results are reported in Table 7.

	Price offers BP		Acceptance thresholds SP	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
q	25.052***	(2.538)	32.501***	(4.085)
v	0.647***	(0.016)	0.566***	(0.030)
Constant	-11.897***	(1.346)	-9.138***	(2.113)
Observations	1845		2070	
R^2	0.925		0.788	

Significance levels : * 10% ** 5% *** 1%

Robust standard errors

Table 7: Effect of the $q-$level on price offers and acceptance thresholds in scenario I (fixed effects)

Estimation results strongly support Hypothesis 3: both, q and v, have a significantly positive effect on price offers and acceptance thresholds. These results suggest that— unlike in blindfolded ultimatum bargaining—proposers anticipate how responders' payoffs are affected by v values and therefore adjust their price offers accordingly.

Supplementing this with our findings for scenario B, we state

Result 4. *In informed ultimatum bargaining, an increase of the $q-$level as well as of value v has a significantly positive effect on price offers and acceptance thresholds. In blindfolded ultimatum bargaining, an increase of the $q-$level has a significantly positive effect on acceptance thresholds only.*

Regarding risk aversion, Hypothesis 7a predicts that, since participants are informed about the size of the pie via v, risk aversion should not affect their decisions. Mirroring our earlier analysis, we estimate an OLS model including the interaction terms discussed earlier. Table 8 reports our results which confirm this prediction.

	(I)		(II)	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
q	1.227***	(0.264)	-7.170	(5.254)
$q = 0.45$			1.522	(1.871)
$q = 0.55$			1.200	(1.563)
$RISK$	-0.014	(1.317)	0.132	(2.376)
$PROP$	-1.962	(1.858)	-1.077	(1.461)
$RISK^{*}q = 0.45$			0.228	(2.004)
$RISK^{*}q = 0.55$			1.454	(1.659)
$RISK^{*}PROP$			-0.997	(2.532)
$FEMALE$	-1.579	(2.039)	-1.561	(2.045)
Constant	31.684***	(1.793)	32.561***	(1.580)
Observations	3915		3915	
R^2	0.006		0.006	
Significance levels : * 10% ** 5% *** 1%				
Standard errors clustered at subject level				

Table 8: Effect of risk aversion in scenario I (OLS)

Complementing this finding with the reported results for blindfolded ultimatum bargaining, we find strong support for Hypothesis 7a and state

Result 5. *Risk aversion affects behavior only in case of blindfolded ultimatum bargaining, i.e., when participants are not informed about the size of the pie.*

4.3. Becoming informed about the surplus from trade: The transition from scenario B to scenario I

Hypothesis 5 predicts that the transition from scenario B to scenario I increases price offers and acceptance thresholds for high v values ($v > 50$) but decreases both variables for low v values ($v \leq 50$). In this latter case proposers' willingness to pay decreases as their gains from trade, $v - BP$, decrease with v; responders, however, are willing to sell the low-valued commodity at a lower price and therefore reduce their acceptance thresholds.

In a first step, we investigate the impact of becoming informed about v on proposer versus responder behavior. To evaluate the effect of the within-subject transition from blindfolded to informed ultimatum bargaining, we estimate a linear fixed effects model including both within-subject treatment variations as explanatory variables: a dummy variable $INFO$ taking unit value for informed ultimatum bargaining and zero value for blindfolded ultimatum bargaining as well as the $q-$level which varied throughout the six rounds of the experiment. Estimation results are reported in Table 9.

	Price offers BP		Acceptance thresholds SP	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
q	7.614***	(2.606)	17.697***	(4.409)
$INFO$	-9.342***	(2.321)	-9.491***	(1.992)
Constant	37.118***	(2.499)	34.862***	(2.772)
Observations	1968		2208	
R^2	0.013		0.019	

Significance levels : $*$ 10% $**$ 5% $***$ 1%

Robust standard errors

Table 9: Effect of becoming informed on price offers and acceptance thresholds (fixed effects)

Estimation results in Table 9 report that $q-$levels have a significantly positive effect on price offers and acceptance thresholds, whereas becoming informed has a significantly negative effect.

Hypothesis 5 predicts that this effect is contingent on value v: becoming informed about v induces higher price offers and acceptance thresholds whenever $v > 50$, whereas for $v \leq 50$, becoming informed induces lower price offers and acceptance thresholds. To investigate this empirically, we reestimate the fixed effects model for observations with $v \leq 50$ (Table 10, column I) and $v > 50$ (Table 10, column II) separately. As the effect of becoming informed is identically negative for proposers and responders (see Table 9), we report results for both jointly, i.e., the dependent variable in our estimations is participants' choice level (price offer or acceptance threshold).[9]

	$v \leq 50$		$v > 50$	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
q	-21.752***	(3.314)	35.520***	(3.078)
$INFO$	-25.459***	(1.606)	8.636***	(1.584)
Constant	51.539***	(2.177)	25.767***	(1.874)
Observations	2349		2088	
R^2	0.415		0.102	

Significance levels : * 10% ** 5% *** 1%

Robust standard errors

Table 10: Effect of becoming informed, distinguishing high versus low v values (fixed effects)

As predicted, informed proposers (responders) choose lower price offers (acceptance thresholds) whenever the value v—reflecting the size of the pie—is low, whereas they choose higher price offers (acceptance thresholds) for high values of v. These findings support Hypothesis 5 and we state

Result 6. *Becoming informed about the size of the pie reduces price offers and acceptance thresholds in case of low values ($v \leq 50$) and increases price offers and acceptance thresholds in case of high values ($v > 50$).*

In fact, the separation of our decision data for high versus low values of v reveals a differing effect of the $q-$level: if v is small, increasing q leads to a significant reduction of price offers and acceptance thresholds, whereas the predicted positive effect of q on price offers and acceptance thresholds (see Hypothesis 3) prevails only if v is high. This suggests that proposers choose lower price offers for small v to assure positive gains from trade, whereas responders—anticipating this—choose lower acceptance thresholds to assure that bargaining is successful.

[9] Reported results are robust to estimating the fixed effects model for proposers and responders separately.

Hypothesis 6 predicts that blindfolded ultimatum bargaining could lead to less successful bargaining in that price offers are more often below the acceptance thresholds, implying no trade. To investigate this, we use actually matched pairs of proposers and responders and estimate a probit model to investigate the effect of becoming informed on the probability that trade will take place.[10] As participants are informed about q in both scenarios, we include the $q-$level to test whether it has a significant impact on the probability of successful bargaining. To test whether risk attitude affects the probability of trade, we further include the dummy variable for individual risk aversion in the estimation. Table 11 reports estimation results.

Variable	**Coefficient**	**(Std. Err.)**
q	-0.645	(0.667)
$INFO$	0.403***	(0.148)
$RISK$	-1.764***	(0.270)
$RISK^{*}PROP$	1.471***	(0.443)
$PROP$	-1.468***	(0.376)
Constant	1.885***	(0.403)
Observations	4176	
Log-likelihood	-2714.871	
$\chi^2_{(5)}$	75.708***	

Significance levels : $*$ 10% $**$ 5% $***$ 1%

Standard errors clustered at subject level

Table 11: Probability of successful bargaining (probit)

As predicted, the probability of trade is affected by participants becoming informed: if proposers and responders know value v, the probability of successful bargaining is significantly higher than in case of blindfolded ultimatum bargaining. Note that this effect contradicts the benchmark analysis, which suggests agreeing on trade irrespective of the specific condition.

Result 7. *Becoming informed about v increases the probability of successful bargaining.*

[10] As we dropped observations with non-monotonic risk preferences, it is possible that only one participant out of a successful pair remained in our data. For this reason we have more price offers (N=1195) which led to successful bargaining than acceptance thresholds (N=1342). We control for this imbalance by including the role dummy $PROP$.

Responders' valuation parameter q, however, has no effect on the probability of successful bargaining. This mirrors our earlier results that price offers and acceptance thresholds (mostly) increase with responders' valuation. As long as they do so proportionally to each other, the probability of trade is left unaffected.

Concerning risk attitude we find an overall negative effect of risk aversion on the probability of successful bargaining. However, the interaction term $RISK^{*}PROP$ is significantly *positive* meaning that the effect of risk aversion is role dependent: while risk averse proposers have a significantly higher probability for successful bargaining, risk averse responders have a significantly lower probability. Recall from Hypothesis 7b that 'failure-risk aversion' leads proposers to choose higher price offers. The observed significantly higher probability of successful bargaining for proposers is caused by higher price offers suggesting that 'failure-risk aversion' drives proposers' decisions. Recall from Hypothesis 7c that 'loss-risk aversion' leads responders to choose higher acceptance thresholds. The observed significantly lower probability of successful bargaining for responders is caused by higher acceptance thresholds hinting at 'loss-risk aversion' driving responders' decisions.

We summarize these findings in

Result 8. *Risk aversion has a significantly positive effect on the probability of successful bargaining, i.e., failure-risk aversion overcompensates loss-risk aversion.*

Supplementing this with our finding that risk attitude has an insignificant effect in scenario I where proposers and responders are informed about the size of the pie, there is no doubt that information about the size of the pie is essential for the probability of successful ultimatum bargaining: while becoming informed directly increases the probability of successful bargaining it additionally offsets the negative impact of risk aversion on successfully bargaining.

Comparing the frequencies with which participants choose the 'benchmark,' 'equal sharing,' or 'golden mean' strategies (see Tables 2 and 6), it seems that the frequency of ϵ-optimal choices increases when becoming informed, whereas the behavioral strategies 'equal sharing' and 'golden mean' are implemented less often when the size of the pie is known. This latter observation would provide support for Hypothesis 8. To substantiate these descriptive findings we investigate the effect of becoming informed on the use of the three strategies. For this we implement a dummy variable for each strategy, taking unit value whenever a chosen price offer or acceptance threshold lies within a 10%-range of the strategy-specific predicted values. Estimation results of the respective probit estimations are reported in Tables 12 to 14.

	$q = 0.35$		$q = 0.45$		$q = 0.55$	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
$INFO$	0.768***	(0.215)	-0.183	(0.203)	-0.118	(0.199)
$PROP$	0.060	(0.064)	-0.080	(0.116)	0.165**	(0.075)
Constant	-1.608***	(0.215)	-1.363***	(0.208)	-1.342***	(0.187)
Observations	1392		1392		1392	
Log-likelihood	-686.817		-308.309		-404.772	
$\chi^2_{(2)}$	15.226***		1.242		5.128*	

Significance levels : * 10% ** 5% *** 1%

Standard errors clustered at subject level

Table 12: Treatment effect on ϵ-optimal choices (probit)

	$q = 0.35$		$q = 0.45$		$q = 0.55$	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
$INFO$	-0.506***	(0.156)	-0.292	(0.180)	-0.753***	(0.165)
$PROP$	-0.264**	(0.103)	-0.237**	(0.109)	-0.062	(0.115)
Constant	-0.784***	(0.176)	-1.040***	(0.185)	-0.709***	(0.159)
Observations	1392		1392		1392	
Log-likelihood	-403.116		-380.652		-371.601	
$\chi^2_{(2)}$	13.971**		6.927**		21.063**	

Significance levels : * 10% ** 5% *** 1%

Standard errors clustered at subject level

Table 13: Treatment effect on equal sharing choices (probit)

As proposed by our descriptive results, becoming informed has a significantly positive effect on the use of the benchmark strategy, but only for a low $q-$level ($q = 0.35$). The significant effect of the $PROP$ dummy, indicating whether a participant is in the role of a proposer or responder, for $q = 0.55$ offers a possible explanation for this restriction: responders trying to avoid negative payoffs choose higher acceptance thresholds in reaction to high $q-$levels—countervailing the information-induced move towards (lower) ϵ-optimal price offers and acceptance thresholds. Further, we find that becoming informed decreases the use of the equal sharing strategy.[11] Lastly, the golden mean strategy is used significantly less often, as proposed. These findings support Hypothesis 8 and suggest that information about the size of the pie induces participants to focus attention on the experimental task rather than to rely on task-independent behavioral strategies like the golden mean or equal sharing. We state

Result 9. *Becoming informed about the size of the pie decreases the use of the task-independent behavioral strategies 'equal sharing' and 'golden mean.'*

	$q = 0.35$		$q = 0.45$		$q = 0.55$	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
$INFO$	-0.356**	(0.165)	-0.686***	(0.134)	-0.361**	(0.143)
$PROP$	0.080	(0.128)	0.057	(0.089)	-0.026	(0.073)
Constant	-0.815***	(0.159)	-0.304**	(0.146)	-0.583***	(0.146)
Observations	1392		1392		1392	
Log-likelihood	-546.306		-648.343		-644.771	
$\chi^2_{(2)}$	4.67***		26.908***		6.606**	

Significance levels : * 10% ** 5% *** 1%

Standard errors clustered at subject level

Table 14: Treatment effect on golden mean choices (probit)

5. Conclusion

Our analysis of how information affects ultimatum bargaining for a random pie suggests one main finding, namely that proposer and responder behavior significantly depends on their information: experimental results significantly differ between blindfolded (both parties are uninformed) and informed ultimatum bargaining (both parties are informed). The transition from the first to the second scenario reflects an important institutional change, e.g., when markets mature and the values of commercial firms, active on such markets, become commonly known.

Our findings add new insights regarding the role of information in ultimatum bargaining: informed participants use the available information to make task-dependent decisions as suggested by the relatively higher use of (nearly) optimal choices whereas uninformed participants more often implement task-independent strategies like equal

[11] The coefficient of the $INFO$ dummy is highly significant for the highest and lowest $q-$levels, but insignificant for $q = 0.45$ (p-value=0.106).

sharing or the golden mean. Participants' risk attitude significantly influences behavior only in blindfolded ultimatum bargaining: becoming informed renders its effect insignificant.

When blindfolded, proposers and responders are more cautious choosing higher price offers and acceptance thresholds. While this suggests that proposers try to ensure successful bargaining, such behavior could also be driven by proposers' anticipation of the cautious and therefore higher acceptance thresholds of responders trying to limit the risk of negative payoffs. Becoming informed decreases price offers and acceptance thresholds, whereas the frequency of successful bargaining increases. Furthermore, while uninformed choices of proposers and responders are adjusted to responders' valuation of the pie, blindfolded choices are adjusted only by responders, even though valuations are common knowledge. The latter finding could be explained by loss averse subjects: including loss aversion in their expected utilities, highly loss averse responders could increase their acceptance thresholds in order to avoid losses. Loss averse proposers, however, anticipating higher responder thresholds, rather leave their price offers unchanged because higher price offers would decrease expected payoffs without substantially decreasing loss probabilities, while decreasing price offers would increase loss probability.[12]

Risk attitude, as expected, affects behavior only in blindfolded ultimatum bargaining where its effect depends on responders' valuation. Overall, risk aversion decreases the probability of successful bargaining suggesting that risk averse proposers and responders mainly try to reduce the risk of negative payoffs rather than the risk of unsuccessful bargaining.

Much of the ultimatum game literature is dedicated to the analysis of other-regarding concerns for reward allocation between proposer and responder. Especially fairness concerns are identified as having substantial implications (see, e.g., Hoffman et al., 1996). We contribute to this literature by pointing out that information about the pie size affects the impact of fairness concerns: for blindfolded bargaining partners fairness concerns are even more pronounced as participants—in lack of other orientation—quite often share expected payoffs equally.

In settings with asymmetric information where either the proposer or the responder is informed about the pie size, the uninformed participant is unaware of what their bargaining partner receives. Becoming informed then induces more equal sharing of

[12] We thank an anonymous referee for pointing out the potential role of loss aversion in explaining our results.

the pie than with one-sided information, i.e., price offers and acceptance thresholds increase (see, e.g., Croson, 1996). At first sight this seems to contradict our finding that equal sharing is used less when becoming informed. However, one has to keep in mind that we assume both, proposer and responder (rather than only one of them), to be uninformed before becoming informed. That is, neither player can exploit superior information in the uninformed setting, whereas with asymmetric information the better informed can choose an unequal offer without this being noticed by his bargaining partner, what allows for one party exploiting the other.

Appendix

A. Experimental instructions

General information

Thank you for participating in this experiment. Please remain silent and turn off your mobile phones. Please read the instructions carefully and note that they are identical for each participant. From now on, you may not talk to other participants. In case you do not follow these rules, we will have to exclude you from the experiment as well as from any payment. You will receive 5 euros for participating in this experiment. The participation fee and any additional amount of money you will earn during the experiment will be paid out to you in cash at the end of the session. All participants will be paid individually, i.e., no other participant will know how much you earned. All monetary amounts in the experiment will be paid in ECU (experimental currency units). At the end, all earned ECUs will be converted into euros using the following exchange rate:

6 ECU = 1 euro.

Procedure

The experiment consists of the following parts: control questions, six rounds divided into two stages, and a final questionnaire. Before starting the first stage, three practice rounds will be held. After completing stage 1, you will receive the instructions for the second stage. At the beginning of the experiment, each participant is randomly assigned one out of two possible roles. One half of the participants will be assigned the role of a buyer, B; the other half will be assigned the role of a seller, S. You will remain in the role you have been assigned throughout the experiment, i.e., in stage 1 and stage 2.

At the end of the experiment, for each of the six rounds, one of your decisions is selected to determine your payment, i.e., one decision per round. If you suffer a loss in the six selected decisions, you can pay for it in cash or balance it by completing additional tasks at the end of the experiment. Please note that these tasks can only be used to compensate for possible losses, but not to increase your earnings. Additionally, you will receive a payment for one task from the questionnaire part. Hence, you will receive the participation fee and payment for the questionnaire part in any case.

Detailed description of the experiment

The experiment consists of two stages, each consisting of three rounds.
The procedure of a round in stage 1 is structured as follows:

1. The computer randomly selects 15 values of v between 0 and incl. 100 ($v = 0, 1, ..., 100$). In this case, each value v between 0 and 100 can be selected with equal probability.
2. Decisions of the participants.

The participant in role B chooses a buying price BP between 0 and incl. 100 ($0 \leq BP \leq 100$).

The participant in role S chooses a minimum selling price SP between 0 and incl. 100 ($0 \leq SP \leq 100$).

In each of the three rounds of stage 1, the randomly selected value of v is not announced to the participants. The uninformed participants only make one decision per round: participants in role S decide to which minimum selling price SP they would be willing to sell, and the participants in role B determine the buying price BP at which they would be willing to buy.

If the buying price BP offered by B is less than the minimum selling price SP offered by seller S, no sale takes place and no gains from the trade are generated, i.e., the earnings of S and B are 0.

If the buying price BP offered by B is higher than or equal to the minimum selling price SP, seller S accepts the bid made by buyer B, and the following earnings result from these choices:

The buyer receives the random value v minus the offered buying price BP.
The seller receives the buying price BP proposed by B minus a share in the amount of $x\%$ of the random value v.
The amount of $x\%$ varies in the three rounds of a stage and can either correspond to 35%, 45%, or 55%, while the sequence of these three x-values is determined randomly.
Therefore, the earnings in the event of a trade can be summarized as follows:

B receives $(v - BP)$,

S receives $(BP - x\%v)$,

where $x\%$ may correspond to either 35%, 45%, or 55%.

Please note that profits from the sale are only positive for both participants – buyer B and seller S – if the randomly selected value v is higher than buying price BP and this, in turn, is higher than $x\%$ v ($v > BP > x\%v$).

If v is less than BP, buyer B receives a negative payoff due to the purchase. If BP is less than $x\%$ v, seller S receives a negative payoff due to the sale.

Therefore, seller S owns a good that has value v for buyer B but is less valuable for the latter, namely $x\%$ of value v. Depending on buying price BP, on $x\%$, and on value v, it can be advantageous for S to sell to B.

You will receive the instructions for stage 2 at the end of stage 1.

Before stage 1 of the experiment begins, we will ask you to answer a few control questions to help you better understand the rules of the experiment. This will be followed by practice rounds to become familiar with the structure of the experiment. If you have any questions, please raise your hand.

INSTRUCTIONS FOR STAGE 2

In each of the three rounds of stage 2, both participants (in role S and B) are confronted with 15 values of v randomly drawn by the computer. Participants in role B decide on a buying price BP for each of the 15 values of $v1, v2, ..., v15$, and participants in role S choose a minimum selling price SP for each of the 15 values. At the end of the experiment, one of these values v is randomly selected for each round and then used to determine the earnings of sellers S and buyers B as in stage 1. The difference to stage 1 consists only in the fact that you make your decisions knowing the 15 different values of v in each of the three rounds -– instead of not knowing the value of v.

B. Random order of v values and $q-$levels

Random order of $q-$levels in phase 1 (blindfolded ultimatum bargaining)

Round	$q-$level
1	0.55
2	0.35
3	0.45

Random order of v values and $q-$levels in phase 2 (informed ultimatum bargaining)

v value	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Round 1 ($q = 0.45$)	18	19	75	24	76	23	73	27	97	1	62	51	93	85	18
Round 2 ($q = 0.55$)	99	22	37	60	62	1	38	3	7	91	93	3	64	87	27
Round 3 ($q = 0.35$)	19	43	38	38	77	26	21	96	64	87	17	79	46	32	94

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