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agreements in favor of residual claimants but also increases bargaining friction.

Bargaining with a Residual Claimant: An Experimental Study*

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Abstract

Many negotiations involve risks that are only resolved ex-post, and often these risks are not incurred equally by the parties involved. We experimentally investigate bargaining situations where a residual claimant faces ex-post risk, whereas a fixed-payoff player does not. In line with the predictions of a benchmark model, we find that residual claimants extract a risk premium, which increases in risk exposure, and that this premium can be high enough to make it beneficial to bargain over a risky rather than a risk-less pie. In contrast to the model's predictions, we find that the comparatively less risk averse residual claimants benefit the most from risk exposure and this is driven by fixed-payoff players' adoption of weak bargaining strategies when the pie is risky. We find evidence for a behavioral mechanism where asymmetric exposure to risk between the two parties creates a wedge between their fairness ideas, which shifts agreements in favor of residual claimants but also increases bargaining friction.

JEL classification codes: C71, C92, D81

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1 Introduction

In many bargaining situations the actual surplus at stake is not known when negotiations take place, and agreements need to be reached before it is revealed. Furthermore, exposure to this risk is often asymmetric. A prominent example are labor-firm negotiations where employees generally receive a fixed salary, whereas the firm faces ex-post risk due to uncertainty over factors such as future demand or costs (Riedl and van Winden, 2012).[1]

This is nicely illustrated by the prominent role asymmetric exposure to risk appears to have played in two high-profile labor negotiations between North American sports leagues and their players' unions: In the National Football League (NFL), one article summarized the negotiating stance of the owners and players as follows, "ownership wants the players to 'buy in' to the fact that running an NFL team requires an enormous allocation of risk not currently shared by the players to an appropriate level" (Brandt, 2011). This suggests that the owners believe that they should be compensated for their risk exposure. However, the article continues, "at one bargaining session, NFLPA representatives responded to the 'shared risk' argument with an offer to also share in profits [. . .] that argument stopped the discussion in its tracks" (Brandt, 2011). This suggests that the players believe that the owners have benefited from the arrangement and that no extra compensation for the owners' risk is justified. Similarly, in the National Hockey League (NHL) it was argued that, "owners bear all of the risk. Players talk about desiring a partnership, but they certainly don't want to share the risk" (Allen, 2012).

These quotations illustrate that asymmetric exposure to risk is used as a negotiating tactic in high-stakes negotiations, and that those exposed to risk believe that they should be compensated for it. Moreover, they show that it is far from clear what effect asymmetric risk exposure has on the different sides at the bargaining table. While the NHL example suggests that exposure to risk is something that both sides would like to minimize, the NFL example suggests that—from the players' perspective—it may have been advantageous to the owners.

Despite its obvious relevance there is no clean empirical evidence on how asymmetric exposure to risk affects bargaining outcomes and how these are related to negotiators' risk preferences and fairness ideas. Using a series of controlled laboratory experiments we provide such evidence. Specifically, we document that the party exposed to risk can actually benefit from this exposure. We also show that under some circumstances residual claimants actively choose to bargain over a riskier distribution, thereby increasing their risk exposure. At

[1] Other examples abound. In supply chains, two common forms of wholesale price contracts between a supplier and a retailer differ in which party bears the ex-post risk of unsold inventory (Cachon, 2004). Randall et al. (2006) report that between 23 and 33% of internet retailers exclusively use wholesale price contracts in which the supplier is responsible for unsold inventory. To get a sense of the money at stake in these relationships, e-commerce sales totaled $304.9 billion in 2014 (U.S. Census Bureau, 2015). In procurement projects, asymmetric exposure to risk arises when two parties transact but only one is liable for any cost overruns, damages, defects or delays. For example, Lam et al. (2007) discusses asymmetric risk exposure in the construction industry and Texas Department of Transportation (2014, e.g., Items 8.6 & 9.4) highlights the risks faced by highway construction and repair contractors.

first sight this may seem counterintuitive, since adding a mean-preserving risk, *while leaving the agreement otherwise unchanged*, cannot improve the residual claimant's welfare if she is risk averse. However, this neglects the fact that when risk increases, the agreement itself must also change. Indeed, there are theoretical arguments proposing that the asymmetric exposure to risk can alter the agreement in favour of the exposed agent to such an extent that it results in higher overall welfare for the exposed agent (White, 2008). We use her model, assuming constant relative risk aversion, to make benchmark predictions on which types can be expected to benefit from risk exposure.

In addition to the theoretical argument there are also behavioral factors that may have a significant influence on bargaining when there is asymmetric risk exposure. In particular, it could create competing ideas of what constitutes a fair allocation, as seems evident in the NFL and NHL labour negotiations examples. Players not exposed to risk (henceforth, fixed-payoff or FP players) might well view the 50-50 split of the expected pie as fair, whereas residual claimants may deem it fair that they are compensated for their risk exposure. Studies have shown that when there are competing fairness ideas in bargaining, agreements often fall between between the two ideas (e.g., Gächter and Riedl, 2005; Bolton and Karagözoğlu, 2016; Karagözoğlu and Riedl, 2015). This suggests that residual claimants will receive some risk premium. However, whether the premium is sufficient to make risk exposure beneficial will depend on how much of the difference between these fairness ideas residual claimants can secure for themselves.

We conduct a series of lab experiments to address the issues discussed and obtain systematic empirical evidence on bargaining behaviour under asymmetric exposure to risk. Specifically, we ask the following questions. First, is the residual claimant able to extract a risk premium for her exposure to risk? Second, how is the risk premium related to the riskiness of the pie? Third, is the risk premium sufficiently large to make residual claimants better off when being exposed to risk? Fourth, what is the role of risk preferences and fairness ideals in bargaining with a residual claimant? Next to bargaining outcomes, we also investigate how the bargaining process is affected by asymmetric risk exposure.[2]

In our bargaining environment, subjects are matched into pairs and are assigned either the role of the residual claimant or the fixed-payoff player. In the main experiments, the pie-distribution is exogenously given and pairs negotiate over a payment to the fixed-payoff player. The residual claimant receives the difference between the realized pie and the agreed payment. Subjects negotiate ten times in randomly rematched pairs, experiencing five different pie-distributions, which are ranked according to second-order stochastic dominance.

Our main results are as follows. In answer to our first two questions: Residual claimants are able to extract a risk premium. On average, fixed-payoff players receive less than half

[2]Other experimental studies have investigated bargaining with one-sided private information on the pie size (see, e.g., Mitzkewitz and Nagel, 1993), an environment notably different from the one we are studying. Somewhat related to our research, Deck and Farmer (2007) study a Nash demand game between two risk neutral parties, with one being a residual claimant. Their focus on arbitration rules differs considerably from our research questions.

of the expected pie and their payment is decreasing in the riskiness of the distribution. Additionally, being more risk averse worsens a subject's bargaining position, especially for fixed-payoff players.[3] In answer to the third question, we find that some residual claimants do benefit from bargaining over a risky pie. However, in partial answer to our fourth question, we find that the relatively less risk averse residual claimants benefit in expected utility terms from their exposure to risk, contrary to the predictions of the benchmark model. These results are complemented by an experiment run using an endogenous design in which residual claimants were able to choose, before bargaining commenced, whether the parties would bargain over a relatively less or relatively more risky pie-distribution. We find that residual claimants choose the riskier pie-distribution over 30% of the time. That is, they directly reveal a preference—presumably because they expect to benefit from it—for bargaining over a riskier pie-distribution. Consistent with our results in the exogenous design, we observe that less risk averse residual claimants are more likely to choose to bargain over a riskier pie-distribution when given the choice.

Our analysis of the bargaining process (opening and final offers, concessions and proposals during bargaining) shows that, when the pie is risky, fixed-payoff players (especially those who are relatively more risk averse) adopt a relatively weaker bargaining strategy. That is, they demand less, they make larger concessions as negotiations drag on and they are more likely to accept a standing offer than their residual claimant counterparts. As a result, these players earn a lower payoff to the advantage of (less risk averse) residual claimants. Rounding out our answer to the fourth question, we find that relative to a risk-free bargaining situation asymmetric exposure to risk increases the frequency of disagreements and decreases the prevalence of 50-50 splits. This result can be attributed to competing notions of what constitutes a fair bargaining outcome, which we show diverge across player roles, especially as risk increases.

2 Experimental Design

Our experimental design consisted of three parts: (i) a bargaining component; (ii) a fairness elicitation; and (iii) a risk elicitation. We first explain in detail the bargaining component, which was the main part of the experiment.

We implemented a free-form tacit bargaining environment in which pairs of subjects have four minutes to exchange offers and reach an agreement, but have no other channel to communicate beyond their offers/demands. One agent is the residual claimant (RC); the other the fixed-payoff player (FP). At the time of bargaining, agents know the distribution

[3]For previous experimental results on bargaining and risk preferences, see Murnighan et al. (1987, 1988) and the references cited therein. These experiments implemented binary and ternary lottery games where the surplus over which subjects are bargaining is in lottery tickets rather than experimental currency units; there is no residual claimant in these environments. Generally, these studies find an effect of risk aversion in the direction predicted by game-theoretic models of bargaining—risk aversion is disadvantageous in bargaining except in situations with agreements that are lotteries with an outcome that is worse than the disagreement outcome—although, they also find large focal point effects.

of possible pie sizes but the actual pie size is unknown to them. The object of negotiation is the amount to be paid to the FP player. An agreement is reached if one player accepts the current proposal of the other player before the expiration of bargaining time. In case of agreement, the FP player receives the agreed upon fixed payment, while the residual claimant receives the realized value of the pie less the fixed payment. If the agents do not reach an agreement before bargaining time expires, then both receive zero.[4]

We chose an unstructured bargaining framework because it provides a natural environment in which players can express their bargaining strategy through the continuous back-and-forth nature of proposals and counter-proposals. The unstructured bargaining environment also provides a rich set of bargaining process data, which can be used to provide further insights into the nature of bargaining.

Subjects participated in 10 rounds of bargaining over a risky pie distribution. The distribution of the pie is exogenously varied from round to round. Five different pie-distributions were implemented using a within-subject design. As a benchmark, one distribution had no risk and subjects bargained over a pie size of €20 for sure. For the risky cases, four pie-distributions with a mean of €20 and mean-preserving spreads were used, varying the extremes of the possible outcomes (low risk versus high risk) and the number of possible outcomes (binary lottery versus ternary lottery). In each pie-distribution, every outcome was equally likely. This within-subject variation was chosen to obtain a direct comparison of how well the same residual claimant does under differing risk conditions.

	Ternary	Binary
Low Risk	(16,20,24)	(16,24)
High Risk	(12,20,28)	(12,28)

Figure 1: Summary of the Pie Distributions with Uncertainty

Figure 1 shows the four risky pie-distributions that were implemented. Fixing the number of possible outcomes (Ternary, Binary), the pie-distribution including the outcomes 12 and 28 is riskier than the one including 16 and 24. Fixing the extremes of the pie-distribution (Low Risk, High Risk), the binary distribution is riskier than the ternary distribution. Finally, it is easy to see that the (16,24) distribution second order stochastically dominates the (12,20,28) distribution. Thus, the ternary-high-risk condition is riskier than the binary-low-risk condition. A further difference between the binary and ternary pie-distributions is that the latter includes the 20 outcome. As a result, with the ternary pie-distributions, it is possible for both agents to earn ex-post the same payoff, should they agree to a 50-50 split of the expected value of the pie. In contrast, with the binary pie-distribution, the 50-50 split of the expected value of the pie necessarily leads to an ex-post unequal outcome. This difference

[4]See Section C of the Supplementary Materials for a complete set of instructions.

may affect bargaining behaviour and outcomes if subjects have concerns for ex-post fairness (Saito, 2013; Cettolin et al., 2017). Subjects experienced each pie-distribution twice.

2.1 Experimental Procedures

We refer to the presented environment for the bargaining component as the *exogenous* design. With this exogenous design, 240 subjects participated in ten sessions across two waves of experiments (two sessions involving 48 subjects were conducted in 2012; eight sessions involving 192 subjects were conducted in 2019, with slightly different procedures as noted below). Each session consisted of 24 subjects split into two matching groups of 12, which were run in parallel on separate z-Tree servers (Fischbacher, 2007), giving 20 matching groups for the exogenous design.[5]

2.1.1 The 2012 Sessions with the Exogenous Design

In these sessions, the aforementioned three parts of the experiment took place in the following order: 10 bargaining rounds (B); incentivized risk elicitation (R); and *unincentivized* fairness elicitation (F). Before bargaining commenced, subjects were randomly assigned either the role of the RC or the FP player, and kept the same role throughout. At the beginning of a bargaining round, subjects were randomly matched within their matching groups into pairs (one RC and one FP) and were informed of the pie-distribution over which they would bargain. During the round, subjects had four minutes to reach an agreement, which was framed as a payment to the FP player.[6] Subjects were free to make as many offers as they wished during this time, and subsequent offers were not required to improve upon one's previous offer. An agreement was reached when one of the two accepted the standing offer of the other player, and subjects received feedback on the size of the pie, their own payoff and that of their match. In case of disagreement both bargaining parties earned nothing. No communication beyond sending and accepting offers was permitted.

During a session, the order of pie-distributions was the same for all subjects in a matching group. However, the order was varied across matching groups, except that in rounds 1 and 10 subjects always bargained over the risk-free pie of €20.[7] In all cases, in the first five rounds all subjects experienced each of the five pie-distributions exactly once. The order in rounds 6 to 9 was the same as in rounds 2 to 5.

[5]During the 2012 wave of experiments, a further 192 subjects participated in 8 sessions run with an *endogenous* design, where residual claimants were given some choice over which pie-distribution to bargain over during the last five rounds. These were run as an alternative test of the welfare implications for residual claimants of bargaining with a riskier pie-distribution. Together with the exogenous design this makes 36 matching groups. For expositional ease, we defer discussing the endogenous design until Section 6.

[6]Proposals were restricted to ensure that the residual claimant would never go bankrupt.

[7]The four orders were: (16,24), (12,28), (16,20,24), (12,20,28); (12,28), (16,24), (12,20,28), (16,20,24); (16,20,24), (12,20,28), (16,24), (12,28); (12,20,28), (16,20,24), (12,28), (16,24). These systematically vary whether the binary lotteries or the ternary lotteries were shown first, and whether the low risk or high risk came first.

Following bargaining, subjects participated in the risk elicitation task. Specifically, we elicited the certainty equivalent for six different binary lotteries using an implementation similar to Cettolin and Tausch (2015) (see also Bruhin et al., 2010).[8] For each subject, the elicited certainty equivalents were used to estimate the ρ parameter assuming a CRRA functional form: $u(x) = (1/(1-\rho))(x^{1-\rho} - 1)$.

Finally, our fairness elicitation collected information on subjects' fairness ideas for the different pie-distributions. Subjects were asked to give their judgement of a fair allocation to the FP player, for each of the five pie-distributions. Specifically, they were asked, "what would be, in your opinion, a 'fair' amount to give to the [fixed-payment player] from the vantage point of a **non-involved neutral arbitrator**". This non-incentivized fairness elicitation procedure has been successfully used before (e.g., Babcock et al., 1995; Gächter and Riedl, 2005). It was completed at the end of the experiment as part of a questionnaire that included questions on demographic and study programme characteristics.

2.1.2 The 2019 Sessions

The eight sessions in 2019 were all with the exogenous design, where me made a few changes in response to comments from anonymous referees. First, in half the sessions the order was: 10 bargaining rounds (B), *incentivized* fairness elicitation (F) and *expanded* risk elicitation (R), while in the other half, the order was R, F and B.

Second, the risk elicitation was expanded to consist of two additional certainty equivalent elicitations (i.e., 8 in total). Moreover, the interface and instructions for the risk elicitation were slightly modified in order to make more clear the nature of the elicitation to minimize errors due to misunderstanding. In addition, we included five questions designed to identify the higher-order risk preference prudence, using a procedure similar to Noussair et al. (2014) but with the lotteries modified to have similar potential payoffs and risks as the standard risk elicitation. The purpose of the prudence elicitation data is to test whether a key necessary condition for the benchmark theoretical mechanism is met. This bar was easily passed: 90% of subjects made the prudent choice at least a majority of the time.

Third, the fairness elicitation was incentivized using the spectator method (Cappelen et al., 2013; Cettolin and Riedl, 2017). Specifically, for each of the five pie distributions, subjects were placed in the same role as during bargaining—i.e., either as an FP or RC player—and asked to make an allocation that could be implemented for *another* pair of subjects consisting of one FP and one RC player. To mitigate any possible spillover effects between the bargaining parts and the fairness elicitation, subjects were explicitly told that the allocation they would implement, if so determined, would be for a pair of subjects that

[8] The six lotteries were: $(15, 1/2; 0, 1/2)$, $(14, 1/2; 6, 1/2)$, $(20, 2/5; 0, 3/5)$, $(18, 1/2; 2, 1/2)$, $(10, 3/4; 0, 1/4)$ and $(12, 2/3; 0, 1/3)$. Lotteries $(14, 1/2; 6, 1/2)$ and $(18, 1/2; 2, 1/2)$ were chosen to provide some gambles similar to those the RC faced in the bargaining task; these are simply the (16,24) and (12,28) pie-distributions minus an FP payment of 10. The other four lotteries were chosen to aid the estimation of CRRA coefficients. Instructions were given via the computer interface after the bargaining task had been completed.

Table 1: Details of the Experimental Sessions

Year	Order	Sessions	Matching Groups	Subjects	Notes
2012	B, R, F	2	4	48	Fairness not incentivized
2019	B, F, R	4	8	96	Fairness incentivized; enhanced risk elicitation
2019	R, F, B	4	8	96	Fairness incentivized; enhanced risk elicitation
2012	B, R, F	8	16	192	Fairness not incentivized; endogenous design

Note: B stands for Bargaining; R stands for Risk Elicitation; and F stands for Fairness elicitation. The endogenous design is discussed in Section 6.

they would never interact (and have never interacted) with in the other parts of the experiment. This was possible because each session was divided into two matching groups. Hence, the fairness allocations were "across matching groups", while the bargaining part occurred "within matching groups". To avoid any potential for anticipated reciprocity within the fairness elicitation, subjects who had their allocation implemented for two other subjects did not receive an allocation from another subject and vice-versa. Subjects who did not receive an allocation were given €3. Lastly, following these three parts, we also conducted exactly the same, unincentivized fairness elicitation as in the 2012 sessions at the end of the session as part of the final questionnaire. Table 1 summarizes the main aspects of the experimental sessions.

The experiments took place at the BEElab of Maastricht University, and all participants were students at Maastricht University recruited using ORSEE (Greiner, 2015). Sessions took approximately 90 (2012 sessions) or 120 (2019 sessions) minutes. In the 2012 sessions, subjects were paid a show-up fee of €2. They also received payment for one randomly selected bargaining round, and the risk-elicitation was similarly incentivized. In the 2019 sessions, no show-up fee was given, but subjects received payment for one randomly selected bargaining round and one randomly selected decision from the risk/prudence elicitation. Additionally, in the fairness elicitation, if subjects were selected to implement an allocation for others, then they would receive €3, while if they were selected to receive an allocation, then they would receive the allocation from a randomly selected other subject for a randomly chosen pie distribution. On average subjects earned €18.77.

3 Theoretical Background and Hypotheses

The theoretical background is provided by White (2006, 2008). Assuming common knowledge of risk preferences, the author provides mild conditions under which the expected receipts of the residual claimant increase with her exposure to risk, and analyses when this increase is large enough to result in higher welfare. The driving force behind her results is the effect of prudence in bargaining. In both alternating-offers bargaining (Rubinstein, 1982) and cooperative Nash bargaining (Nash, 1950), the curvature of an agent's utility function is a key determinant of the allocation an agent will receive. All else equal, a more risk averse agent values an additional dollar less than the previous dollar. Therefore, in the alternating-offers setting, she is less willing to hold out to make a more advantageous counteroffer. In the Nash bargaining solution, which maximizes the Nash product, as risk aversion increases, the share allocated to the agent decreases because the marginal impact on the Nash product of an additional dollar gets smaller.

To illustrate that exposure to risk could be beneficial for an agent, consider adding a mean-preserving spread to a risk averse agent's payment. Under the assumption of decreasing absolute risk aversion, marginal utility is a convex function. Consequently, holding the original agreement fixed, the expected marginal utility of the agent exposed to risk has increased relative to the risk-free case. Thus, the new agreement must shift away from the risk-free agreement in favor of the agent exposed to risk. Whether she ultimately benefits in utility terms from exposure to ex-post risk will also depend on the preferences of the fixed-payoff player since his marginal utility may increase as the agreement moves in favor of the residual claimant.[9]

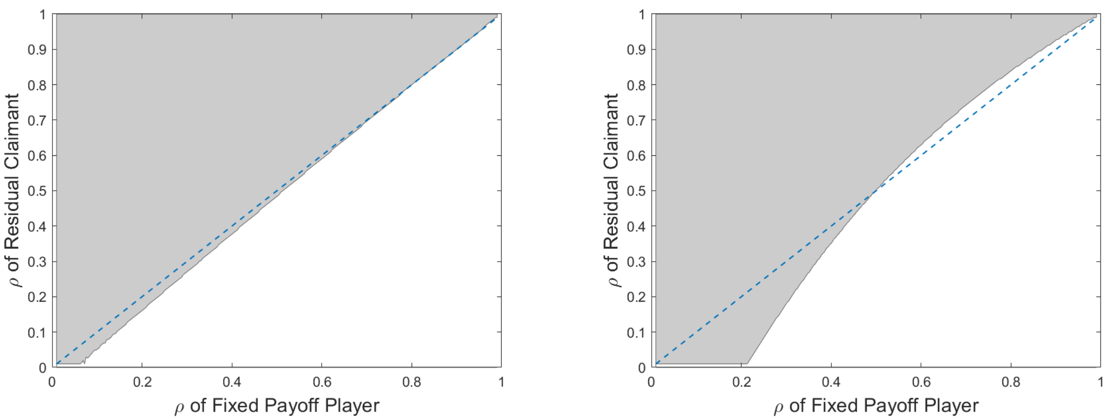
Since we implement free-form bargaining in our experiments, we apply the Nash bargaining solution to provide a theoretical benchmark. In what follows, we give the specific predictions for the implemented environment with common knowledge of preferences. The Nash bargaining solution is found by maximising the product of the expected utilities of the FP and RC players. In our setting, given that the amount to divide is a random variable, π, the solution is a payment to the FP player, y, that maximises the Nash product: $u_{FP}(y) \cdot \mathbb{E}_{\pi}\left[u_{RC}(\pi - y)\right]$. For a fixed distribution, since disagreement represents the worst outcome, the solution will have the usual comparative statics with respect to the players' utility functions: for either player, greater concavity in their utility function will result in a lower share of the bargaining surplus (see, for example, Roth and Rothblum, 1982).

Fixing the preferences of the players, Proposition 6 of White (2006) states that a residual claimant's expected share of the pie will increase with the addition of a small additive risk, compared to the no risk case. That is, the fixed payment to the FP player will decrease as risk increases.[10] However, a decreasing payment to the FP player does not always imply increasing welfare for the RC player. Proposition 7 of White (2006) provides a necessary and sufficient condition for the RC's welfare to improve with a small additive risk, compared

[9]The intuition is reminiscent of a result from the precautionary savings literature. Kimball (1990) showed that, with additive risk, a decision maker exhibiting decreasing absolute risk aversion (DARA) will *increase* her savings when her future income becomes risky. That is, the introduction of risk effectively makes the decision maker more patient.

[10]This holds under a mild condition that is always satisfied under both constant relative risk aversion (CRRA) and constant absolute risk aversion (CARA).

to the no risk case. Under CRRA risk preferences, this will be true whenever the residual claimant is *more* risk averse than the FP player.[11,12]



(a) $(16, 20, 24)$ **(b)** $(12, 28)$

Note: In the grey region RC players are predicted to do better in expected utility terms. The broken 45-degree line indicates the locus for which the RC and FP players have identical risk preferences. These figures are drawn under the assumption that players have, commonly known, CRRA utility functions. The parameter ρ represents the CRRA risk parameter, where $\rho = 0$ implies risk neutrality.

Figure 2: Region of players' risk parameters over which exposure to risk is advantageous for RC players

In our experiment, the risks the RC player is exposed to are not small and White's Proposition 7 will not hold exactly. Indeed, numerical calculations show that the residual claimant being more risk averse than the FP player is neither necessary nor sufficient for the RC's welfare to improve when exposed to the risks in our experiment. However, it is still a useful approximation as can be seen in Figure 2. This figure plots in grey the region of risk preference parameter values over which RCs are predicted to do better in expected utility terms when moving from the riskless pie (€20) to one of the two risky pie distributions implemented in the experiment. Panel (a) depicts the region for the $(16, 20, 24)$ pie-distribution, which is the least risky of the uncertain pie-distributions, while panel (b) depicts the region for the $(12, 28)$ pie-distribution, which is the most risky. The 45 degree line indicates the locus for which the RC and FP players have identical risk preferences.

[11] Simple calculations show that this condition can never be satisfied under CARA risk preferences. Holt and Laury (2002) find evidence for increasing relative risk aversion but decreasing absolute risk aversion. However, both Harrison and Rutström (2008) and Wilcox (2008) highlight that the finding of increasing relative risk aversion is highly dependent on the estimation procedure, and argue that constant relative risk aversion cannot be rejected.

[12] Identification of the result relies on subjects taking a narrow frame to the risks displayed in the experiment—that is, they display small-stakes risk aversion, which we capture by assuming CRRA utility over the payoffs from the experiment. Cox and Sadiraj (2006) argue that this small-stakes risk aversion need not generate absurd behavior over larger stakes as in the Rabin (2000) critique. Indeed, a recent experiment by Harrison et al. (2017) finds evidence that one of the main premises underlying this critique did not hold for a large sample of undergraduate students.

The above discussion leads us to the following set of hypotheses:[13]

Hypothesis 1 (White, 2006, 2008) *The amount allocated to the fixed-payoff player declines as the riskiness of the pie-distribution increases.*

Hypothesis 2 (Roth and Rothblum, 1982) *Holding the pie-distribution constant, the amount allocated to the fixed-payoff player is decreasing in own risk aversion and increasing in the residual claimant's risk aversion. This holds for all pie-distributions, provided that the residual claimant is risk averse.*

Hypothesis 3 (White, 2006, 2008) (a) *Residual claimants can benefit in welfare terms from adding a mean-preserving risk to their receipts.* (b) *To a first approximation, whenever the residual claimant is* ***more*** *risk averse than the fixed-payoff player, the residual claimant's welfare will be higher when faced with a risky pie-distribution than when faced with a riskless pie-distribution.*

In addition to the above, the following hypothesis regarding disagreements is a direct consequence of the Pareto optimality axiom built into the Nash bargaining solution concept:

Hypothesis 4 (Nash, 1950) *Across all pie-distributions, the frequency of agreements is 100%.*

Our free-form bargaining environment allows us to not only analyze bargaining outcomes, but also the bargaining process. Although the theoretical benchmark model is silent about that aspect, we can use an idea of Zeuthen (1930) to shine some light on it. He suggested a behavioral model of the bargaining process based on his concession principle, which states that the next concession must come from the player with the least willingness to face the risk of a conflict. Harsanyi (1977) extended this idea and demonstrated its close connection to the Nash bargaining solution. The idea is that a player's willingness to face the risk of conflict is measured by their risk limit, which is defined as the ratio of their utility gain from getting their offer rather than the other's and their utility gain of getting their offer rather than disagreement. As shown in Harsanyi (1977), comparing players' risk limits for a given set of offers is equivalent to comparing the Nash product of the offers. Based on this argument the following benchmark hypothesis for the concession process can be formulated.

Hypothesis 5 *Given open but incompatible offers from the FP and RC players, the player who has the lower risk limit will be the one who is more likely to make the next concession.*

Of course, there may be factors at play not considered by the benchmark model. Most prominently, fairness-driven bargaining behavior or private information of risk preferences could have a significant influence on bargaining, especially with the addition of asymmetric exposure to risk. We discuss how these might impact our benchmark hypotheses below.

[13] See Section B.1 of the Supplementary Materials for a graphical illustration of Hypotheses 1–3.

3.1 Fairness-Driven Bargaining Behavior

We expect that asymmetric exposure to risk will create competing beliefs for what constitutes a fair allocation. For example, the fixed-payoff players may think that the 50-50 split of the expected pie is a fair allocation, whereas residual claimants may deem it fair that they are compensated for their exposure to risk and, thus, may feel entitled to more than half of the expected pie. Prior bargaining studies have shown that when there are competing fairness ideas, agreements often fall between allocations reflecting these ideas (see, e.g., Gächter and Riedl, 2005; Karagözoğlu and Riedl, 2015; Bolton and Karagözoğlu, 2016).

To provide more structure to how such fairness ideas might impact our benchmark hypotheses, we follow the approach taken in Bolton and Karagözoğlu (2016), who consider a social preference modification of the Nash bargaining solution (NBS) in an environment with two competing fairness ideas, with one advantageous to player 1 and the other advantageous to player 2. The main idea is that, to avoid disagreement a player could always concede to the fairness idea that is advantageous to the other player. The result is a *fairness-adjusted* NBS, where each player's disagreement utility is given by the amount they would receive under the other player's perceived fair allocation. In our setting, it is natural to think that there are two prevalent self-serving fairness ideas (e.g., Babcock et al., 1995): The FP player may try to argue that the players should ignore risk and just divide the expected pie evenly, whereas the RC player may argue that some compensation for risk is fair.

Without risk it is reasonable to expect the fairness ideas to be symmetric and split the surplus 50-50. In which case, the fairness-adjusted NBS would predict a prevalence of 50-50 splits irrespective of each players' risk preferences, since there is no surplus over which to negotiate beyond satisfying each other's fairness-driven bargaining positions. With the introduction of ex-post risk, the perceived fair payment to the FP player from the perspective of the residual claimant is likely to be decreasing in the riskiness of the pie-distribution to compensate risk averse residual claimants for being exposed to the risk (i.e. the residual claimant should get more compensation for risk when there is greater risk).[14] This divergence in self-serving fairness ideas opens a new channel through which exposure to risk affects bargaining outcomes, over and above the prudence mechanism identified in White (2008). Furthermore, the fixed payoff players find themselves in a more difficult bargaining position as their associated fairness idea does not change with ex-post risk, while that of the residual claimants is moving in a way that can only reduce the FP player's likely payment. Now it is the less risk averse residual claimants that are likely to benefit from the introduction of risk, since the less risk averse they are the more they can pull the agreement towards their own

[14] Unlike Bolton and Karagözoğlu (2016), where the competing fairness ideas are clear, there is more ambiguity about the fairness idea for the residual claimant in our setting. For our purposes, we only need: (i) that both parties perceive a 50-50 split of the surplus as fair in the absence of risk in the pie-distribution; and, (ii) that the perceived fair payment to the FP player from the perspective of the residual claimant is decreasing in the riskiness of the pie-distribution, while a 50-50 split of the expected surplus remains the perceived fair outcome for fixed payoff players. For simplicity, we do not consider fairness ideas that are specific to the risk attitude of the residual claimant.

fairness idea, extracting a greater proportion of the surplus that remains between the two fairness-adjusted disagreement points.[15]

These arguments suggest that the residual claimant will generally receive a premium for their exposure to risk, and that being more risk averse is, other things being equal, a disadvantage in bargaining, at least in the cases with risky pie-distributions. Consequently, the introduction of fairness-driven bargaining behavior does not alter Hypotheses 1 and 2. Furthermore, the opening up of a wedge between the self-serving fairness ideas for residual claimants and fixed payoff players, along with the prudence mechanism, also leads to the prediction that residual claimants can benefit in welfare terms from their exposure as in Hypothesis 3(A). However, the likely effect of risk preferences is the opposite of the one stated in Hypothesis 3(B). We, therefore, formulate the following alternative hypothesis.

HYPOTHESIS 3 (B ALT) *The less risk averse RC players are more likely to benefit in welfare terms when faced with a risky pie-distribution compared with a risk-less pie-distribution.*

It is an axiom for the Nash bargaining solution that agents would always reach a Pareto-improving agreement. However, in real bargaining disagreements are frequently observed. Recent literature suggests that under risk there may be a conflict between ex-ante and ex-post fair outcomes (Fudenberg and Levine, 2012; Brock et al., 2013; Cettolin and Riedl, 2017), which may generate disagreements even if agents would otherwise agree in situations without risk. Birkeland and Tungodden (2014) propose a theoretical model which explicitly incorporates conflicting fairness ideals in a bargaining model. They show that disagreement may arise when players' fairness ideas diverge too much. In our case, such divergence is likely because each player type can easily adopt a self-serving fairness idea. Moreover, as the RC's desired compensation for bearing risk is predicted to increase with the riskiness of the pie-distribution, so may the tension between self-servingly biased fairness ideas. The fairness-adjusted model of Bolton and Karagözoğlu (2016) includes a small probability of a player being non-compromising; that is, they would rather disagree than accept an allocation that gives them less then *their own* perceived fair allocation. In their model, in the risk-free case, no disagreement is predicted irrespective of player types because fairness ideas (i.e., equal-split) are compatible. However, divergent fairness ideas and the possibility that two non-compromisers meet implies that bargaining with a risky pie-distribution could result in disagreement.[16] Together, these theoretical arguments suggest the following alternative hypothesis regarding the frequency of agreements:

[15] See Section B.2 of the Supplementary Materials for explicit details of the fairness-adjusted NBS set-up and predictions. In particular, Figure B.3 provides an analogy to Figure 2, showing the region of players' risk parameters over which risk is advantageous for residual claimants.

[16] Non-compromisers are included in Bolton and Karagözoğlu (2016) to make the fairness ideas credible. The simple formulation of a fixed probability of players being a compromiser or non-compromiser means that the probability of disagreement is the same irrespective of the degree of divergence in fairness-ideas. The authors consider using the probability of meeting a non-compromiser as a way of modeling the credibility of a fairness-idea, something that would be needed to generate the prediction of increasing disagreement rates when the risky pie-distribution gets riskier or when comparing between two risky pie-distributions.

Hypothesis 4 (alt) *Disagreements are more likely to occur for risky pie-distributions than for the risk-less one. The frequency of disagreements increases with the riskiness of the pie-distributions.*

Regarding concession behavior, Bolton and Karagözoğlu (2016) established a bargaining process analogous to the Harsanyi-Zeuthen process introduced above and established an equivalence result for their fairness-adjusted Nash bargaining solution. Using their arguments, we can formulate the following alternative hypotheses concerning concession behavior, when fairness ideas play a role in bargaining.[17]

Hypothesis 5 (alt) *When bargaining over risky pie-distributions, given incompatible open offers from the FP and RC players, which lie between their fairness ideas, the player who has the lower fairness-adjusted risk limit will be one who is more likely to make the next concession.*

3.2 Incomplete Information

In both the benchmark model and the fairness-adjusted behavioral alternative, players are assumed to have common knowledge of all the important parameters of the environment. This implies that bargaining parties should know each other's preferences and, for the behavioral alternative, additionally, each other's fairness ideas.

Extensions of the cooperative Nash bargaining solution concept to the case of incomplete information typically involve parties negotiating over more complex objects than offers and counter-offers. Since offers over divisions of the surplus can reveal valuable private information, in such extensions, parties bargain over whole mechanisms, which are then implemented once an agreement has been reached (see Myerson, 1991, chapter 10). It is beyond the scope of this paper to provide a formal treatment of the incomplete information case. However, Section B.4 of the Supplementary Materials provides a numerical analysis of several possible specifications for the extension of the Nash bargaining solution suggested by Myerson (1979).

This analysis finds that residual claimants can benefit from there exposure to risk, in line with Hypothesis 3(A). However, whether more or less risk averse residual claimants are most likely to benefit from ex-post risk depends on the details of the type-space. Our numerical analysis suggests that it is more likely to be the *less* risk averse type who benefits, as long as risk aversion is not too pronounced for the least risk averse type. Finally, when risk preferences are private information, disagreement may occur as part of the solution. Interestingly, the numerical analysis shows that the frequency of disagreement may actually *decrease* when the riskiness of the pie-distribution increases.

[17] See Section B.3 of the Supplementary Materials for details.

3.3 Overall Summary

All of the models discussed generally agree that FP players earnings should decrease as risk increases. Moreover, there is also agreement that *some* residual claimants may actually benefit in welfare terms from bargaining over a risky pie-distribution (relative to the risk-free case). However, there is less agreement on *which* residual claimants can be expected to benefit from risk exposure. In the results section we will, among other things, test those predictions about which the models agree and report insights about actual behavior where the models disagree.

4 Results

We begin our analysis by focussing on outcomes to understand how asymmetric exposure to risk affects bargaining outcomes in the residual claimant environment (Hypotheses 1 and 2). We then address the questions of whether there is any evidence that residual claimants might benefit, or expect to benefit, in welfare terms from their exposure to risk, and if so which risk preference types of residual claimant benefit (Hypothesis 3). Throughout, statistical significance is established using a regression-based approach with cluster-robust standard errors that allow for arbitrary correlation between observations within a matching group. Non-parametric tests on matching-group averages were run as a robustness check.[18] behavior is also not noticeably affected by the order in which tasks were conducted in the different sessions.

4.1 Bargaining Outcomes in the Exogenous Design

Table 2 presents a summary of the bargaining outcomes. As can be seen from the second column, the FP players' final earnings are, on average, less than half of the expected pie of 10 for each pie-distribution (ordered from risk-free to riskiest). This average, however, includes the disagreement payment of zero when the players fail to reach an agreement. Focusing on agreements, which is the primary concern of the benchmark model, in all risky pie-distributions the average agreed FP payment is less than half the equal split of the expected value (10) and decreasing in the riskiness of the pie-distribution (see third column).[19]

Disagreement rates range from 3.8% to 11.3% and are somewhat lower than in other studies using free-form bargaining—see, e.g., Roth et al. (1988) and Gächter and Riedl (2005) who report disagreement rates of approximately 23% and 16%, respectively. As can be seen,

[18]These robustness checks are reported in Appendix A (Tables A.2 and A.3). There are no substantive differences between the two sets of tests. Appendix A.1 also contains tests for differences in risk preferences (noted in the text), key outcome variables and fairness ideas between the different session types (broken down by pie-distribution in Table A.1). There are only minor differences in measured risk and fairness preferences between 2012 and 2019, and

[19]In Appendix A, the top two panels of Tables A.2 and A.3 show that most of these pairwise comparisons are statistically significant for final FP earnings and agreed FP payments (17 out of 20). The latter result is also shown in the regression analysis reported in Table 3.

Table 2: Bargaining Outcomes and Fairness Ideas in the Exogenous Design

Distribution of Pie	Final FP Earnings (€)	Agreed FP Payments (€)	Disagreements (%)	Remaining Time (sec)	Fairness Ideas (€ to FP) FP	RC
(20)	9.67 (2.06)	10.05 (0.79)	3.8 (19)	169 (82)	10.34 (1.44)	9.89 (1.86)
$(16, 20, 24)$	8.86 (3.16)	9.76 (1.50)	9.2 (29)	87 (88)	10.62 (1.72)	9.57 (1.11)
$(16, 24)$	8.87 (3.02)	9.64 (1.59)	7.9 (27)	75 (82)	10.58 (1.52)	9.47 (1.44)
$(12, 20, 28)$	8.24 (3.20)	9.29 (1.36)	11.3 (32)	61 (79)	10.05 (1.28)	8.47 (1.83)
$(12, 28)$	8.04 (3.02)	8.86 (1.69)	9.2 (29)	71 (87)	9.79 (1.33)	8.18 (1.64)

Notes: Standard deviations are reported in parentheses. 'Final FP Earnings' averages include the disagreement payment of zero when players fail to reach an agreement; 'Agreed FP Payments' averages do not. 'Remaining time' is the average time left when an agreement was reached (and as such is conditional on an agreement). The columns 'Fairness Ideas (€ to FP)' report the judgements of a fair allocation to the FP player. The first of these is the average allocation reported by those assigned the FP role; the second, the average reported by those assigned the RC role.

there is a stark difference in bargaining duration between when the pie is risky and when it is not, but the average time remaining does not appear to be sensitive to the amount of risk, just that the pie is risky. Fairness ideas, shown in the last two columns, diverge as the riskiness of the pie-distribution increases. FP players generally view at least the 50-50 division as fair, while many residual claimants report a fair allocation that compensates them for their risk.[20] Note that, for all pie-distributions with risk, average agreed payments are between the (self-serving) fairness perceptions of the RC and the FP players.

The regression results reported in Table 3 investigate Hypotheses 1 and 2 directly. The dependent variable in these random-effects regressions is the agreed payment to the FP player (that is, payments conditional on agreements). The indicator variables $\mathbf{1}[(\cdot)]$ take value 1 for the indicated pie-distribution and 0 otherwise. The risk-free pie-distribution is the reference category. The first specification confirms that, in comparison to the risk-free pie-distribution, risky pie-distributions significantly reduce the agreed payment to FP players for all risky pie-distributions. The second specification uses the variance of the risky pie-distributions, normalized so that the variance of the riskiest pie-distribution is one, as a single measure of riskiness and shows that this also captures the effect of this treatment variation. This supports Hypotheses 1.

Building upon specification (2), the last two columns include estimates of the risk aversion parameter of the FP (ρ_{FP}) and RC (ρ_{RC}) players as explanatory variables. These specifications test Hypothesis 2. The coefficient on ρ_{FP} is significantly negative, while for ρ_{RC} it is positive but not significant. That is, fixing the pie-distribution, being more risk averse does not improve RC players' bargaining position, while strictly worsening it for FP players. The role of risk aversion is clearly muted for RC players, having a marginally significant effect only after controlling for the interaction between ρ_{RC} and risk in specification (4)—i.e., only after controlling for the moderating role risk has for the RC player. Overall, risk preferences affect the agreed FP payment in the direction predicted by the benchmark model; while for

[20]The fairness assessments of the RC players are below those of the FP players when there is risk, as a regression-based test with standard errors clustered at the matching-group level shows. Going in order of increasing riskiness, the p-values are $0.041, < 0.001, < 0.001, < 0.001$ and < 0.001, respectively.

Table 3: Linear Random-Effects Regression of Agreed Payments to the FP Player

	Agreed FP Payments			
	(1)	(2)	(3)	(4)
$\mathbf{1}[(16, 20, 24)]$	-0.28^{**} (0.110)			
$\mathbf{1}[(16, 24)]$	-0.39^{***} (0.112)			
$\mathbf{1}[(12, 20, 28)]$	-0.71^{***} (0.153)			
$\mathbf{1}[(12, 28)]$	-1.14^{***} (0.152)			
Variance		-1.06^{***} (0.142)	-1.06^{***} (0.143)	-1.00^{***} (0.188)
ρ_{FP}			-0.71^{***} (0.275)	-0.71^{***} (0.275)
ρ_{RC}			0.31 (0.214)	0.41^{*} (0.234)
$\rho_{RC}\times$ Var.				-0.24 (0.314)
Constant	10.02^{***} (0.047)	9.96^{***} (0.052)	10.03^{***} (0.095)	10.00^{***} (0.097)
R^2	0.07	0.07	0.09	0.09
Observations	1002	1002	1002	1002

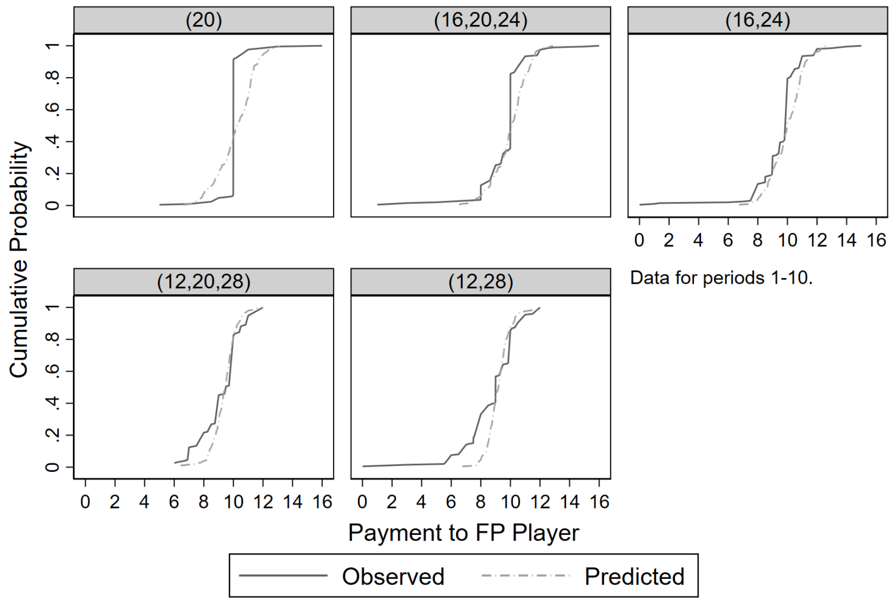
Note: Data include only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

fixed risk preferences of the FP and RC, increasing the risk of the pie-distribution improves the bargaining position of the latter.[21]

While the regressions reported in Table 3 show that agreed payments vary with risk preferences largely in line with Hypothesis 2, a stronger test would be to examine the relationship between the agreed payment predicted by the Nash bargaining solution, given the elicited risk preferences of the bargaining pair. Figure 3(a) plots the cumulative distribution of agreed and predicted payments. This figure provides a number of insights. First, when there is no risk (panel (20)), nearly all agreements are a 50-50 division of the pie. That is, differences in preferences lose salience and the fairness idea of equal division dominates. This is consistent with the Bolton and Karagözoğlu (2016) model. Second, for the risky pie-distributions, there is a correspondence between the observed and predicted division of payoffs. However, agreed FP payments are, on average, smaller than predicted by the theoretical model, as can be seen in Figure 3(b). This table reports the results of a linear-random effects regression where the dependent variable is the agreed FP Payment and as explanatory variables we include the predicted Nash bargaining solution (NBS), indicator variables for the risky pie-distributions, and their interaction. The positive coefficients on the NBS interactions shows that the NBS does have some predictive power for the agreements, while the negative coefficients on the indicators show that, when there is risk, FP players receive, uniformly, less. We summarize the above discussion in the following result.

Result 1 (Bargaining Outcomes) *Asymmetric exposure to risk affects important bargaining outcomes in a way consistent with the benchmark model: (1) average agreed payments to the fixed-payoff player decrease as the pie-distribution becomes more risky; (2) increased risk aversion reduces the average surplus share for a player, in particular for the fixed-payoff*

[21]For convenience, here we keep the focus on the riskiness of the pie distribution and risk preferences. In subsequent analysis, we will consider the role of fairness and other factors.



(a) Comparing Predicted vs Empirical CDF

$\mathbf{1}[(16,20,24)]$	-2.39^{**}	(1.064)
$\mathbf{1}[(16,24)]$	-2.37^{**}	(0.989)
$\mathbf{1}[(12,20,28)]$	-2.02^{*}	(1.170)
$\mathbf{1}[(12,28)]$	-4.12^{***}	(1.223)
Nash Bargaining Solution (NBS)	0.05	(0.063)
$\mathbf{1}[(16,20,24)]\times$ NBS	0.21^{*}	(0.108)
$\mathbf{1}[(16,24)]\times$ NBS	0.20^{**}	(0.094)
$\mathbf{1}[(12,20,28)]\times$ NBS	0.14	(0.123)
$\mathbf{1}[(12,28)]\times$ NBS	0.33^{**}	(0.132)
Constant	9.49^{***}	(0.625)
R^2	0.10	
Observations	2004	

(b) Linear Random-Effects Regression of Agreed FP Payment on Predicted NBS Payment

Note: Data include only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

Figure 3: Observed Versus Predicted Agreed Payments to the FP Player

player, holding constant the pie-distribution and bargaining partner. There is also significant evidence for bargaining behavior being consistent with a fairness-adjusted model as (3) with no pie-distribution risk, the equal split of the pie is the predominant agreement and (4) with risky pie-distributions agreements lie between the two players' fairness ideals.

4.2 Residual Claimant Welfare

Hypothesis 3 concerns the question of whether the welfare of a residual claimant could be increased by bargaining over a risky pie-distribution rather than a risk-free pie distribution. That is, is the observed reduction in FP payments when bargaining over a risky pie-distribution sufficient to compensate RC players for the disutility of bearing risk? In Table 4 we consider two different approaches to answer this question. The first is more indirect but uses the full sample of agreements, while the second is more direct but only uses a subset of the data—in particular, those instances in which the same two subjects (one FP player and one RC player) bargained in two periods, once when the pie-distribution was riskless and once when it was risky. In both cases, we take the agreed FP payment and calculate the certainty equivalent of the RC player using the RC player's estimated risk parameter.

Column (1) of Table 4(a) reports the results of the former, more indirect, analysis. If Hypothesis 3(B) were correct—so that residual claimants benefit from exposure to risk when they are more risk averse than the FP player—then the coefficient $\mathbf{1}[\text{Var} > 0] \times \mathbf{1}[\rho_{RC} > \rho_{FP}]$ should be positive, as should the sum of this coefficient and the coefficients for $\mathbf{1}[\text{Var.} > 0]$ and $\mathbf{1}[\rho_{RC} > \rho_{FP}]$. As can be seen from the table, neither of these are true. Therefore, while we find evidence of residual claimants benefiting in welfare terms from their exposure to risk in line with part (A) of Hypothesis 3, it is actually those residual claimants who are *less* risk averse than their fixed-payoff counterparts who are the ones benefiting, contrary to part (B) of the hypothesis. Indeed column (2) of Table 4(a)—which replaces the indicator variable for the RC player being more risk averse than the FP player with an indicator for whether the RC player has an estimated ρ_{RC} greater than the median estimated risk parameter in our sample—suggests that it is the less risk averse RC players more generally that benefit, in line with our behavioral alternative, Hypothesis 3(B ALT).

Panel (b) focuses on the subset of the data in which the same pairs of FP and RC players bargained once with a relatively less risky (lr) pie-distribution and once with a relatively more risky (hr) pie-distribution. The first panel considers a random-effects logistic regression where the dependent variable takes value 1 if the residual claimant had a higher certainty equivalent under the relatively riskier distribution (i.e., $CE^a_{hr} - CE^a_{lr} > 0$). The explanatory variables include an indicator for the predicted difference being positive (i.e., $CE^a_{hr} - CE^a_{lr} > 0$), as well as our measures of risk preferences for both player types. Observe that if the subjects behave as in the theoretical model, then only the indicator variable should matter. However, as can be seen, this variable is small in magnitude and not significant. Instead, consistent with our earlier results, risk preferences matter. The residual claimant is significantly more likely to benefit when bargaining over the riskier distribution the *more* risk averse is the FP player and the *less* risk averse she, herself, is. The second column takes a linear regression and uses the actual and predicted differences in certainty equivalents as the dependent and explanatory variables, respectively. The results are comparable. The predicted difference in certainty equivalents has no explanatory power, while risk preferences do matter and in the direction suggested by the alternative behavioural Hypothesis 3(B ALT). We summarize the above discussion in our next result.

RESULT 2 (RESIDUAL CLAIMANT WELFARE) *In line with with the benchmark model we find evidence that residual claimants can benefit in welfare terms from their exposure to risk (Hypothesis* 3(A)). *Contrary to the benchmark model, but consistent with the behavioral alternative, it is the relatively less risk averse residual claimants that are likely to be the ones to benefit from risk exposure (Hypothesis* 3(B ALT)).

Table 4: An Analysis of Certainty Equivalents

(a) Linear Random-Effects Regression of the Certainty Equivalent of Agreements for RC Players

	(1)	(2)
Constant	9.81^{***} (0.067)	10.01^{***} (0.046)
$\mathbf{1}[\text{Var.} > 0]$	0.80^{***} (0.144)	0.64^{***} (0.129)
$\mathbf{1}[\rho_{RC} > \rho_{FP}]$	0.28^{**} (0.128)	
$\mathbf{1}[\rho_{RC} > \rho_{RC}^{median}]$		-0.06 (0.121)
$\mathbf{1}[\text{Var.} > 0] \times \mathbf{1}[\rho_{RC} > \rho_{FP}]$	-1.12^{***} (0.185)	
$\mathbf{1}[\text{Var.} > 0] \times \mathbf{1}[\rho_{RC} > \rho_{RC}^{median}]$		-1.00^{***} (0.188)
R^2	0.08	0.08
Observations	1002	1002

(b) An Analysis of Matched-Pair Outcomes: Higher vs. Lower Risk

	(1)	(2)
$\mathbf{1}[CE_{hr}^p - CE_{lr}^p > 0]$	0.15 (0.380)	
$CE_{hr}^p - CE_{lr}^p$		-1.13 (0.832)
ρ_{FP}	1.44^{**} (0.649)	0.65^{*} (0.369)
ρ_{RC}	-2.30^{***} (0.588)	-1.18^{***} (0.205)
$\rho_{FP} \times \rho_{RC}$	-1.96 (1.728)	-1.60^{**} (0.795)
Constant	0.14 (0.334)	0.37^{***} (0.076)
Log-Like/R^2	-357.17	0.073
Observations	596	596
Dependent Variable	RC Benefits in Riskier; i.e., $\mathbf{1}[CE_{hr}^a - CE_{lr}^a > 0]$	$CE_{hr}^a - CE_{lr}^a$

Note 1. In both panels, data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level. Note 2. Panel (a) linear random-effects regression; panel (b) random effects models; (1) estimates logit model, (2) linear model. Note 3. $\rho_{RC}^{median} = 0.305$ is the median value of elicited risk coefficients for the residual claimants. Note 4. In Panel (b), CE_y^x, where $x \in \{a, p\}$ and $y \in \{lr, hr\}$, stands for the predicted (p) or actual (a) certainty equivalent for the lower risk (lr) or higher risk (hr) pie-distribution.

4.3 Bargaining Frictions

The disagreements and time remaining columns of Table 2 show that the presence of risk also increases bargaining frictions. Disagreements are significantly more frequent when bargaining over a risky pie-distribution than when bargaining over a riskless pie-distribution. Furthermore, when an agreement is reached, it occurs with significantly less time remaining until the deadline when the pie-distribution is risky than when it is not.[22]

Result 3 (Bargaining Frictions) *Contrary to the benchmark model (Hypothesis 4), but consistent with the behavioral alternative (Hypothesis 4(*alt*)), disagreements are (significantly) more frequent when the pie-distribution is risky than when it is not. Further, bargaining duration is longer when bargaining over a risky, rather than riskless, pie-distribution.*

5 Bargaining Process

Thus far the analysis has focused on bargaining outcomes, for which the benchmark and alternative models make predictions. We now explore other aspects of the bargaining process data on which these models are mostly silent. The overall picture that emerges from this analysis is that the presence of risk creates a wedge between the fairness ideas of both parties, leading to different bargaining postures by the FP and RC players, as well as greater conflict. Furthermore, risk attitudes play an important role, particularly for FP players, with relatively more risk averse FP players adopting weaker bargaining strategies.

5.1 First and Final Offers

Table 5 examines the opening offers, final offers (offers outstanding either at the time of agreement or the expiry of bargaining time) and the fairness ideas of both player types for each pie-distribution. Unsurprisingly, opening offers of the RC players are always significantly lower than those of the FP player (Wilcoxon signed-rank tests; $p < 0.01$). Consistent with Bolton and Karagözoğlu (2016), opening offers are more extreme than subjects' reported fairness ideals. In their opening offers, RC players always demand a risk premium whenever they are exposed to risk, and this premium is increasing in pie-distribution risk. While FP players tend to demand less as risk increases, their opening offers are consistently above half the expected pie size.

The two middle columns of Table 5 show a similar pattern for final offers. Both the RC and FP players concede ground from their opening positions. While the final offer of RCs is still significantly lower than that of the FP players, the average difference is now only €1.56, as compared to €4.66 for opening offers. Relative to the certain pie-distribution, RC players still demand a risk premium for all the risky pie-distributions, and it is statistically significant for all but the least risky (non-degenerate) pie-distribution. The FP players concede a

[22] For the associated pairwise comparisons, see Table A.2 in Appendix A. See Section E.1 of the supplementary materials for details.

Table 5: Opening and Final Offers to FP Players by Player Type

Distribution of Pie	Opening Offers FP	Opening Offers RC	Final Offers FP	Final Offers RC	Fairness Ideas (€ to FP) FP	Fairness Ideas (€ to FP) RC
(20)	12.03	8.43	10.80	9.36	10.34	9.89
(16,20,24)	12.76	7.41	10.58	9.11	10.62	9.57
(16,24)	12.37	7.39	10.55	8.93	10.58	9.47
(12,20,28)	11.09	6.55	9.85	8.29	10.05	8.47
(12,28)	10.88	6.28	9.45	7.79	9.79	8.18

Notes: The lightly (darkly) shaded cells are significantly different from offers for the (20) pie-distribution at the 1% (5%) level. Comparing both opening and final offers between FP and RC player, the differences are always statistically significant at the 1% level. For all tests we use Wilcoxon signed rank tests using the matching group average (for the particular type or pie-distribution) as the unit of independent observation. We have 20 matching groups overall.

statistically significant risk premium to the RC player for the two riskiest pie-distributions, while for the others they still demand more than half the pie, on average. We also see that for all risky pie-distributions, the final offers of FP players are approximately equal to or even below their fairness idea, which means that, on average, they tend to concede even more than they think is fair. In contrast, for RC players, their final proposals are less than their fairness idea, which means that their last offer is unfair in a way that benefits them.

Table 6: Linear Random-Effects Regressions of the Role of Risk Preferences and Offers

	Opening Offer FP		Opening Offer RC		Agreed FP Payments		Disagreements	
$\mathbf{1}[(16,20,24)]$	0.75^{***}	(0.242)	-0.90^{***}	(0.269)	-0.25^{*}	(0.142)	0.03	(0.031)
$\mathbf{1}[(16,24)]$	0.46	(0.287)	-1.00^{***}	(0.222)	-0.38^{**}	(0.158)	0.01	(0.030)
$\mathbf{1}[(12,20,28)]$	-0.86^{***}	(0.221)	-1.50^{***}	(0.243)	-0.38^{**}	(0.166)	0.05^{*}	(0.028)
$\mathbf{1}[(12,28)]$	-1.02^{***}	(0.273)	-1.68^{***}	(0.228)	-0.73^{***}	(0.202)	0.02	(0.025)
ρ_{FP}	-0.26	(0.470)			-0.42^{**}	(0.205)	-0.01	(0.042)
ρ_{RC}			0.07	(0.472)	0.48^{**}	(0.190)	-0.02	(0.038)
Fairness Idea (FP)	0.16^{*}	(0.087)			0.01	(0.038)	0.02^{***}	(0.007)
Fairness Idea (RC)			0.23^{***}	(0.059)	0.12^{**}	(0.060)	-0.01	(0.008)
Opening offer FP					0.09^{***}	(0.031)	0.01	(0.005)
Opening offer RC					0.12^{***}	(0.039)	-0.01	(0.006)
(Time 1^{st} offer FP)/100					1.02^{***}	(0.236)	0.13^{**}	(0.062)
(Time 1^{st} offer RC)/100					-0.11	(0.191)	0.02	(0.055)
Δ(Time $1^{st}-2^{nd}$ offer FP)/100					0.38^{**}	(0.168)	0.09	(0.057)
Δ(Time $1^{st}-2^{nd}$ offer RC)/100					-0.22	(0.178)	-0.03	(0.041)
Constant	10.38^{***}	(0.897)	6.07^{***}	(0.529)	6.52^{***}	(0.790)	-0.13	(0.093)
R^2	0.14		0.14		0.20		0.04	
Observations	1034		1003		1440		1608	

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

Table 6 reports results of more detailed regression analyses of offers. The first two columns show that opening offers are, surprisingly, not significantly influenced by agents' risk preferences. However, we do see that fairness ideas significantly (positively) affect first offers for both FP and RC players.[23] The third and fourth columns show that fairness ideas also affect the payment, conditional on an agreement, to the FP player, as well as the likelihood of disagreement. Specifically, RC players who think FP players deserve more make agreements which, in fact, give more to the FP player, while FP players who think that they deserve more are more likely to see bargaining end in disagreement.

The third column of the table also shows that opening offers are not cheap talk. Specifically, consistent with Galinsky and Mussweiler (2001), Bolton and Karagözoğlu (2016) and others, we see that final agreements are *anchored* on the opening offers of both players. There is a significantly positive relationship between the opening offer of both the FP and RC players and the agreed payment to the FP player. Therefore, an FP player who initially demands more, or an RC player who initially offers less, are likely to end up with a more favorable outcome, assuming an agreement can be reached. Although risk preferences do not seem to affect opening offers (first and second columns), consistent with Result 1, they do affect final outcomes (third column) in a manner consistent with the benchmark model: holding the pie-distribution constant, increased risk aversion weakens one's bargaining position.

Finally, the third and fourth columns of Table 6 also control for the time at which players made their first offer and the amount of time that they waited between making their first and second offer. These two variables are meant to capture aspects of a player's bargaining posture. For example, someone who makes an opening offer but then never amends it may be trying to "stick to his guns". The results show that the FP player can earn more by delaying making a first offer and also by delaying making his/her first concession (third column); however, the strategy is risky as delaying making an offer also significantly increases the chance of disagreement (fourth column).

Result 4 (Initial and Final Offers) *(1) Fairness ideas are positively associated with opening and final offers, but players adopt adversarial initial positions relative to these fairness ideas, with the bargaining process bringing final offers closer to the fairness ideals. (2) Average final offers acknowledge, at least with the riskiest pie-distributions, that the RC player should be compensated for her exposure to risk. (3) Opening offers are uncorrelated with estimated risk coefficients, but risk attitudes are strongly associated with the subsequent bargaining process. (4) With risk, FP players concede down to or below their fairness ideas, while RC players do not concede up to their fairness idea. (5) Opening offers are positively associated with agreed payments, but do not significantly affect the likelihood of disagreement.*

5.2 Concessions and Proposals During Bargaining

The Harsanyi-Zeuthen concession principle generates explicit predictions for the identity of the player making the next concession for both the benchmark and fairness-adjusted NBS

[23]The same regressions as for opening offers, but for final offers, show fairness ideas matter throughout the bargaining process. For FP players, the coefficient is 0.11 ($p < 0.01$), while for RC players, the coefficient is 0.15 ($p = 0.015$).

models. Table 7 presents a regression analysis testing these predictions.[24] The dependent variable is an indicator of whether the residual claimant was the one to concede. The prediction is that the RC player concedes if their risk limit (RL_{RC}) is lower than the risk limit of the FP player (RL_{FP}). In the table, the first two columns use the standard NBS concept, and its associated risk limit, to build an indicator for when the residual claimant is predicted to concede. The third and fourth columns use an adjusted risk limit associated with the fairness-adjusted NBS. The two risk limits can differ due to differing disagreement utilities.

Table 7: Linear Regression of RC Concession: Benchmark versus Fairness Adjusted Predictions

	Benchmark		Fairness-Adjusted		Horse Race	
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbf{1}[RL_{RC} \leq RL_{FP}]$	0.17***	0.29***			0.08***	0.17***
	(0.000)	(0.000)			(0.002)	(0.000)
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]$			0.30***	0.41***	0.26***	0.36***
			(0.000)	(0.000)	(0.000)	(0.000)
Constant	0.43***	0.51***	0.35***	0.37***	0.33***	0.37***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	4241	4241	2455	2455	2455	2455
Clusters	20	20	20	20	20	20
R^2	0.03	0.10	0.09	0.19	0.09	0.19
Average predicted probability of concession by the RC when:						
$\mathbf{1}[RL_{RC} > RL_{FP}]$	0.43	0.36			0.50	0.45
$\mathbf{1}[RL_{RC} \leq RL_{FP}]$	0.59	0.64			0.58	0.61
$\mathbf{1}[RL_{RC}^{adj} > RL_{FP}^{adj}]$			0.35	0.29	0.38	0.32
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]$			0.66	0.70	0.64	0.68
$\mathbf{1}[RL_{RC} > RL_{FP}] \times \mathbf{1}[RL_{RC}^{adj} > RL_{FP}^{adj}]$					0.33	0.22
$\mathbf{1}[RL_{RC} \leq RL_{FP}] \times \mathbf{1}[RL_{RC}^{adj} > RL_{FP}^{adj}]$					0.41	0.39
$\mathbf{1}[RL_{RC} > RL_{FP}] \times \mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]$					0.60	0.58
$\mathbf{1}[RL_{RC} \leq RL_{FP}] \times \mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]$					0.67	0.74

Notes: RL^{adj} denotes the fairness-adjusted calculation of risk limit. Data includes only observations with $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level. Models (1) and (3) are simple linear regressions; models (2) and (4) include subject level fixed effects (see Table D.3 of the Supplementary Materials for details on modelling unobserved heterogeneity); in all cases, adding controls for unobserved heterogeneity at the subject or group level increases size and significance of the risk limit variables.

As can be seen in columns (1)–(4), both the benchmark NBS and fairness-adjusted NBS models result in risk limit comparisons that are significantly associated with the identity of the party making the next concession. In all cases, an RC player is more likely to be

[24] Section D of the Supplementary Materials reports details of this analysis. The Harsanyi-Zeuthen concession principle makes predictions about the identity of the player making a subsequent concession, rather than whether there is a standoff and whether the subsequent standoff ends with a concession. Consequently, the analysis focuses on episodes where there are open and incompatible offers from both parties (i.e., a standoff) and one party subsequently concedes to the other (See Tables D.1 and D.2 for a breakdown of the category of observations across pie-distributions). A concession can take the form of an acceptance of the other's offer or a new offer with terms more favourable to the other player but still incompatible with their current demand.

the one to concede when their risk limit is less than the FP player's, while the opposite holds if the risk limit is larger. This is consistent with both Hypotheses 5 and 5 (ALT). The last two columns consider a horse-race specification that includes both the benchmark and fairness adjusted predictions. Both models are informative, with neither model strictly dominating the other, but the fairness-adjusted model has a larger estimated contribution.[25] Overall, the two measures of risk limit are strongly associated with the identity of the person making the next concession. If the residual claimant has both risk limits lower, the predicted probability that they will concede is over two-thirds; when both are higher, this probability halves to below one-third. The Harsanyi-Zeuthen concession principle, however, does not make predictions for the content of proposals and the size of concessions.

Table 8 reports an analysis of the proposals made during bargaining in Panel (a) and on whether the residual claimant accepts in Panel (b). Consider first the proposals models. The dependent variable is the player's current proposal (i.e., the amount proposed to the FP player). As explanatory variables, we include the player's elicited risk parameter and either the time the offer was made (columns (1) and (3)) or the proposal number (columns (2) and (4)), as well as an interaction between the risk parameter and, respectively, proposal number and proposal time. Lastly, the specification also includes indicator variables for the pie-distribution.

Consistent with Table 6, which looked at first offers, RC players offer less and FP players claim less as the riskiness of the pie-distribution increases. Moreover, as would be expected from a gradual concession process, FP players' claims are decreasing over time and proposal number, while RC players' offers are increasing with these variables. Also consistent with Table 6, there is little direct effect of risk preferences. However, for FP players, there is an interaction effect which suggests that more risk averse FP players concede more over time and number of offers. In contrast, for RC players, more risk averse RC players actually concede modestly less across offers.

The main message from Table 6 and Table 8(a) is that FP players take weaker initial positions as the riskiness of the pie-distribution increases. Furthermore, risk aversion negatively impacts FP players throughout the concession process, with more risk averse players conceding significantly more over time and number of proposals. In contrast, residual claimants take stronger initial positions and their concession process is less influenced by risk preferences, as risk increases.

Table 8(b) analyzes acceptance behavior of RC players. The dependent variable is an indicator that takes value 1 if the RC player was the one who accepted. As can be seen, RC players are somewhat less likely to accept when the pie is risky. Moreover, we also see that

[25] More detailed analysis of the role of the pie-distribution risk shows that, while the benchmark model is equally informative across the pie-distributions, the fairness-adjusted model makes better predictions in the risk-less and less risky distributions (see Table D.4 of Section D of the Supplementary Materials). An important element that the fairness-adjusted model brings over and above the benchmark model is the prediction that, when just one player makes an offer inconsistent with the fairness ideas it is this player that is likely to concede; this happens less often in the riskier pie-distributions (see Figure D.1).

Table 8: Linear Random-Effects Regression on Proposal Behaviour and Acceptances

(a) Proposals

	FP Player				RC Player			
	(1)		(2)		(3)		(4)	
(Own) ρ	-0.14	(0.560)	-0.14	(0.463)	0.38	(0.611)	0.76	(0.488)
Time	-0.75^{***}	(0.080)			0.88^{***}	(0.173)		
(Own) $\rho \times$ Time	-0.39^{**}	(0.196)			0.05	(0.299)		
Offer Number			-0.05^{***}	(0.010)			0.04^{***}	(0.009)
(Own) $\rho \times$ Offer Num.			-0.06^{***}	(0.018)			-0.05^{*}	(0.027)
$\mathbf{1}[(16, 20, 24)]$	-0.14	(0.258)	-0.26	(0.264)	-0.95^{***}	(0.299)	-0.79^{***}	(0.293)
$\mathbf{1}[(16, 24)]$	-0.41	(0.274)	-0.56^{*}	(0.297)	-1.06^{***}	(0.237)	-0.90^{***}	(0.222)
$\mathbf{1}[(12, 20, 28)]$	-1.51^{***}	(0.305)	-1.59^{***}	(0.294)	-1.74^{***}	(0.237)	-1.54^{***}	(0.223)
$\mathbf{1}[(12, 28)]$	-1.72^{***}	(0.339)	-1.86^{***}	(0.356)	-2.14^{***}	(0.259)	-1.94^{***}	(0.245)
Constant	12.56^{***}	(0.344)	12.24^{***}	(0.317)	8.01^{***}	(0.330)	8.49^{***}	(0.264)
R^2	0.20		0.15		0.07		0.04	
Observations	7441		7441		7697		7697	

(b) Residual Claimant Accepts

	RC Accepts	
$\mathbf{1}[\text{Var.} > 0]$	-0.08^{*}	(0.041)
ρ_{FP}	-0.19^{***}	(0.065)
ρ_{RC}	0.08	(0.060)
Final Offer RC	-0.05^{***}	(0.009)
Final Offer FP	-0.06^{***}	(0.011)
Constant	1.64^{***}	(0.116)
R^2	0.09	
Observations	855	

Notes: FP = Fixed-payoff player; RC = Residual claimant. In panel (b), "Final Offer x" is the last proposal made by player type x before the end of bargaining for that period. Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

coefficient on the risk parameter of the FP player is negative and significant. That is, the more risk averse the FP player, the more likely they are to be the one ultimately accepting, again suggesting that more risk averse FP players are in a relatively weaker bargaining position than less risk averse ones. Finally, we also observe the intuitive result that RC players are the less likely to accept, the more advantageous to the FP player the final offer on table is, irrespective of who made the final offer.

Result 5 (Concessions and Proposals) *(1) Risk attitudes and fairness ideas are associated with the concessions and proposals process. (2) Both standard and fairness-adjusted risk limit measures help predict which player will make the next concession. (3) More risk averse FP players make larger concessions as negotiations continue and are more likely to accept the RC's offer than are less risk averse FP players.*

6 Discussion

Our results show that risk-exposed residual claimants are generally able to extract a risk premium from the fixed-payoff player and this premium is increasing in the riskiness of the pie-distribution. Furthermore, the premium can be large enough to make it beneficial (in expected utility terms) for residual claimants to bargain with some ex-post risk. This naturally leads to the question, do residual claimants judge for themselves that they are likely to be better off when being exposed to risk? That is, when given the choice between distributions, would a residual claimant choose into the one with more ex-post risk? Indeed, the conclusion of White (2008) suggests a preference of residual claimants to bargain with asymmetric exposure could play a role in explaining the contractual incompleteness that is commonly observed in bargained agreements.

We sought to address this question directly via a set of sessions run using an endogenous design, which we briefly discuss below. The results from these sessions are strongly consistent with those from the exogenous design sessions: residual claimants can benefit sufficiently from asymmetric exposure to risk to choose into bargaining with the exposure, and it is the less risk averse residual claimants that are more likely to do so. This latter point is contrary to the prudence-based mechanism analysed in White (2008).

In addition to this, we also discuss alternative explanations for our mixed results with regard to the benchmark model. We highlight the evidence for an additional channel through which asymmetric exposure to risk can have substantive impacts on bargained agreements: the wedge asymmetric exposure to risk creates between the fairness ideas of the two bargaining parties, and the impact of fairness ideas on bargaining.

6.1 Endogenous Choice of Pie-Distribution Risk

The sessions involving endogenous choice of risk consisted of ten rounds, split into an exogenous and an endogenous part. Rounds 1–5 were the same as in the exogenous design, which has been our focus until now. During rounds 6–10, in contrast, the residual claimant was asked which of two pie-distributions they would prefer to bargain over. The choice was always between two pie-distributions where one was a mean-preserving spread of the other.[26] Overall, about one-third of residual claimants choices were to bargain over the riskier of the two pie-distributions and there were notably more risky choices when the choice was between a certain pie (i.e., €20) and a ternary pie-distribution (i.e., either $(16, 20, 24)$ or $(12, 20, 28)$;

[26]The choices in periods 6–10 were: certain versus ternary, certain versus binary, ternary versus binary, $(16, 20, 24)$ versus $(12, 20, 28)$, and $(16, 24)$ versus $(12, 28)$. In half of the sessions, the low risk binary and ternary distributions were used during periods 6–8; in the other half, the high risk were used in these periods. In half of the sessions, the RC's chosen pie-distribution was always implemented (transparent treatment); in the other half, the RC's choice was implemented 70% of the time (non-transparent treatment). See Section F of the supplementary materials for details of the design, as well as further results from these sessions including: an explicit analysis of the transparent versus non-transparent treatment; bargaining outcomes during the first periods, with exogenously chosen pie-distributions; and bargaining outcomes over the last five periods, with endogenously chosen ones.

Table 9: Linear Random-Effects Regression of Choice of Pie-Distribution (Periods 6-10)

	Riskier Pie-Distribution Chosen		
	(1)	(2)	(3)
$\mathbf{1}$[Certain versus Binary]	-0.20^{***} (0.068)		
$\mathbf{1}$[Ternary versus Binary]	-0.26^{***} (0.050)		
$\mathbf{1}$[(16,20,24) versus (12,20,28)]	-0.29^{***} (0.050)		
$\mathbf{1}$[(16,24) versus (12,28)]	-0.29^{***} (0.058)		
Difference in Variance		0.05 (0.075)	
$\mathbf{1}$[Certain versus Ternary]		0.26^{***} (0.039)	0.26^{***} (0.039)
ρ_{RC}			-0.21^{***} (0.076)
Constant	0.54^{***} (0.041)	0.25^{***} (0.036)	0.34^{***} (0.035)
R^2	0.05	0.05	0.06
Observations	455	455	455

Notes: Data includes only observations for which $|\rho_{RC}| < 1$. ***1%, **5%, *10% significance using standard errors clustered at the matching group level. In (1), Certain versus Ternary is the baseline category. Variables $\mathbf{1}[\cdot]$ are indicator variables assuming value 1 for the respective alternative and 0 otherwise. Difference in Variance variable normalized so that the largest difference (Certain versus (12,28)) is equal to one.

note that the ternary pie-distributions are the only risky distributions that allow for an equal split ex-post). In these cases, just over 50% of RC players chose the riskier ternary pie-distribution. The statistical significance of this result is established in specification (1) of the regression analysis reported in Table 9, where the certain versus ternary alternative is the baseline. The regression shows that, in comparison to certain versus ternary, there is a significantly lower rate of riskier pie-distribution choice for any other alternative.[27] These regression results suggest that residual claimants were most likely to prefer bargaining over a risky pie-distribution, rather than the expected value for sure, when there is the possibility of an ex-post equal split.

Specification (3) of Table 9 addresses the second part of Hypothesis 3(B), stating that when the residual claimant is more risk averse than the fixed-payoff player then she can benefit from exposure to a riskier pie-distribution. However, the analysis shows that the likelihood of choosing the riskier pie-distribution is decreasing in the risk aversion of the RC player, which goes against the prediction of the benchmark model, but is entirely consistent with the results from the exogenous design. Recall that we found that it was the relatively less risk averse RC players that appeared to benefit from bargaining over a risky pie-distribution.

6.2 Alternative Explanations

There are several reasons why the benchmark model prediction about which risk preferences types benefit from risk exposure are not borne out in the data. First, the results show that

[27] The effect is similar across the four indicator variables and it is not possible to reject the null hypothesis that all the coefficients are equal ($p = 0.604$). Specification (2) of Table 9 illustrates that this effect is not a result of the difference in risk: it shows a significantly positive effect for choosing the riskier pie-distribution in certain vs ternary even after controlling for the difference in variances of the pie-distributions.

risk leads to a divergence in what players consider to be fair: residual claimants believe that fairness demands compensation for risk, while FP players believe fairness means an equal split of the expected value of the pie. Second, initial and final proposals by FP players are positively correlated with their ideas about what constitutes a fair division. Third, disagreement rates were higher with risk. Thus, fairness ideas matter in bargaining, and the addition of risk appears to place a wedge between the FP and RC players' fairness ideas, thereby increasing disagreements.

Another key driver is the behavior of fixed-payoff players. They are found to adopt weak bargaining strategies in risky environments, especially those who are more risk averse. These players demand less from the start, make larger concessions, and are more likely to accept. Together, these factors go a long way in explaining why the relatively less risk averse residual claimants benefit the most from risk exposure. This observation is consistent with the predictions of the fairness-adjusted Nash bargaining solution (Bolton and Karagözoğlu, 2016): The fixed-payoff players' self-serving fairness idea is to split the expected surplus 50-50 and barely changes with the change in risk. In contrast, the fairness idea advantageous to the residual claimants improves the terms for them as their exposure to risk increases (cf. Table 5). Consequently, with the addition of risk, the fairness-adjusted Nash Bargaining solution predicts an increase in the effective frontier over which the agents are bargaining compared to the 50-50 split of the expected surplus, but only to include outcomes that are more advantageous to the residual claimant.

We cannot rule out that private information of risk preferences also plays a role, because it also predicts that the less risk averse residual claimants are most likely to benefit from risk. However, it is unlikely that private information alone provides a sufficient explanation of our results. Not least, a simulation study of various specifications of private information of risk preferences predicts that disagreements should decline as risk increases, in contrast to both intuition and observed disagreement rates. Thus, while private information may play a role, an interaction between fairness ideas, risk preferences and risk exposure, as described above, appears to be more compelling.

7 Conclusion

This paper reports the results of an experimental study on the effect of asymmetric exposure to risk in bargaining. Our results show that risk-exposed residual claimants are generally able to extract a risk premium from the fixed-payoff player and the premium is increasing in the riskiness of the pie-distribution. Furthermore, this premium can be large enough to make it beneficial (in expected utility terms) for residual claimants to bargain with some ex-post risk. That is, we find empirical support for the prediction from a theoretical benchmark model (White, 2006, 2008) that risk exposure can be beneficial in bargaining.

This benchmark model predicts—via a prudence mechanism—that it should be the relatively more risk averse residual claimants who benefit from risk exposure. While nearly all of our subjects' made decisions consistent with prudence a majority of the time, our results show that it is the comparatively *less* risk averse residual claimants who are most likely to benefit. Therefore, the reason why residual claimants benefit from risk must be something other than the prudence channel alone, as identified by White (2006, 2008). We find that fixed-payoff players adopt weak bargaining strategies when the pie is risky, which is an important driver of our results. Moreover, we identify the interaction between fairness ideals and risk exposure as an important factor. Specifically, asymmetric exposure to risk between the two parties creates a wedge between their fairness ideas and shifts the agreement towards residual claimants, sometimes, so much that they can benefit from risk exposure.

Circling back to our introduction, where we provided suggestive evidence that asymmetric exposure to risk is an important factor—at least as a negotiating tactic—in bargaining situations in the field, we now have controlled laboratory evidence of its importance. Our result, that it is possible for residual claimants to benefit from risk, is consistent with the perception that NFL owners have benefited from their risk exposure. Moreover, the behavioral channel that we identified is also consistent with these labor negotiations; namely, that asymmetric exposure to risk creates a wedge between what each party perceives as fair.

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Appendix

A Additional Material

A.1 Examining Order Effects

We first examine whether there are differences in the elicited risk preferences across the various types of sessions. Recall that in all cases, in the 2012 sessions, risk preferences were elicited after bargaining but before the unincentivized fairness elicitation, while in the 2019 sessions, risk preferences were either elicited at the beginning or at the end of the experiment. The average CRRA risk parameters were 0.350, 0.224 and 0.198, respectively for sessions 2012-BRF, 2019-BFR and 2019-RFB.[28] As is evident, there is no significant difference between the two 2019 session types ($p = 0.543$), but subjects do appear to be less risk averse in 2019 than in 2012 ($p = 0.003$). Of course, because of the significant lag between the 2012 and 2019 sessions, we cannot attribute the differences to the changes in the elicitation procedure. What we do see is that, in the 2019 sessions, the order does not appear to matter.

In Table A.1, we provide summary statistics on key outcome variables (Agreed FP Payment and Disagreement) as well as the fairness idea of each player type, broken down by pie-distribution and session type. Highlighted cells indicate a statistically significant difference between the two session types for the particular pie-distribution at the 5% level based on a Mann-Whitney rank-sum test. As can be seen, of the 60 possible pairwise comparisons, only two are significant at the 5% level, which is well within the bounds of chance.[29] The most noticeable differences appear to be that residual claimants do not demand quite as large of a risk premium when fairness preferences are elicited first.

[28]As in the main body of the paper, we focus only on those subjects for which $|\rho| < 1$. See Note 2 in Table A.1 for what these session type acronyms mean.

[29]If we consider the 10% level of significance then we see that 8 of 60 pairwise comparisons meet the threshold, which is also not far from what could be expected by chance.

Table A.1: A Comparison of Key Bargaining Outcomes and Fairness Ideas by Session Type

(a) Agreed FP Payment

Distribution of Pie	Session 2019-BFR	2019-RFB	2012-BRF
(20)	9.97	10.08	10.13
(16, 20, 24)	9.71	9.87	9.64
(16, 24)	9.45	9.86	9.56
(12, 20, 28)	9.29	9.41	9.04
(12, 28)	8.70	9.05	8.79

(b) Disagreement (%)

Distribution of Pie	Session 2019-BFR	2019-RFB	2012-BRF
(20)	5.21	2.08	4.17
(16, 20, 24)	9.38	10.42	6.25
(16, 24)	5.21	7.29	14.58
(12, 20, 28)	12.50	10.42	10.42
(12, 28)	6.25	7.29	18.75

(c) Fairness Idea (FP Player)

Distribution of Pie	Session 2019-BFR	2019-RFB	2012-BRF
(20)	10.25	10.63	9.96
(16, 20, 24)	10.39	10.99	10.33
(16, 24)	10.32	10.98	10.29
(12, 20, 28)	10.07	10.13	9.88
(12, 28)	9.85	9.82	9.58

(d) Fairness Idea (RC Player)

Distribution of Pie	Session 2019-BFR	2019-RFB	2012-BRF
(20)	9.55	10.21	9.92
(16, 20, 24)	9.57	9.65	9.44
(16, 24)	9.11	9.84	9.44
(12, 20, 28)	7.99	8.98	8.42
(12, 28)	7.92	8.50	8.06

Note 1: The numbers in each cell represent the matching group average, broken down by pie-distribution and session type. In the column headings, B stands for Bargaining; R stands for Risk Elicitation; and F stands for Fairness elicitation, and the triple represents the order in which students completed the tasks.
Note 2: Cells which are shaded in grey indicate that the variables are significantly different from each other at the 5% level or better according to a Mann-Whitney rank-sum test.

A.2 Tables

Table A.2: Pairwise Comparison of Bargaining Outcomes in the Exogenous Design (Periods 1-10)

	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)
	Final Earnings					*Agreed FP Payments*				
(20)	9.67	$>^{***}$	$>^{***}$	$>^{***}$	$>^{***}$	10.05	$>^{**}$	$>^{***}$	$>^{***}$	$>^{***}$
(16,20,24)		8.86	$<$	$>^{***}$	$>^{***}$		9.78	$>$	$>^{***}$	$>^{***}$
(16,24)			8.87	$>^{**}$	$>^{***}$			9.64	$>^{***}$	$>^{***}$
(12,20,28)				8.24	$>$				9.31	$>^{***}$
(12,28)					8.04					8.86
	Disagreements					*Time Remaining*				
(20)	3.8	$<^{***}$	$<^{*}$	$<^{***}$	$<^{**}$	168	$>^{***}$	$>^{***}$	$>^{***}$	$>^{***}$
(16,20,24)		9.2	$>$	$<$	$>$		85	$>^{*}$	$>^{***}$	$>^{*}$
(16,24)			7.9	$<$	$<$			74	$>^{**}$	$>$
(12,20,28)				11.2	$>$				60	$<$
(12,28)					9.2					70

Notes: The symbol indicates how the outcome measure of the row distribution compares (statistically) to the column distribution. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

Table A.3: Pairwise Comparison of Bargaining Outcomes in the Exogenous Design (Periods 1-10) – Robustness Check using Matching Group Averages

	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)
	Final Earnings					*Agreed FP Payments*				
(20)	9.67	$>^{***}$	$>^{**}$	$>^{***}$	$>^{***}$	10.05	$>^{**}$	$>^{***}$	$>^{***}$	$>^{***}$
(16,20,24)		8.86	$<$	$>^{**}$	$>^{***}$		9.76	$>$	$>^{***}$	$>^{***}$
(16,24)			8.87	$>^{**}$	$>^{***}$			9.64	$>^{**}$	$>^{***}$
(12,20,28)				8.24	$>$				9.29	$>^{***}$
(12,28)					8.04					8.86
	Disagreements					*Time Remaining*				
(20)	3.8	$<^{***}$	$<$	$<^{***}$	$<^{**}$	169	$>^{***}$	$>^{***}$	$>^{***}$	$>^{***}$
(16,20,24)		9.2	$>$	$<$	$>$		87	$>^{**}$	$>^{***}$	$>^{**}$
(16,24)			7.9	$<$	$<$			75	$>^{**}$	$>$
(12,20,28)				11.2	$>$				61	$<$
(12,28)					9.2					71

Notes: The symbol indicates how the outcome measure of the row distribution compares (statistically) to the column distribution. ***1%, **5%, *10% significance using signed rank test on matching-group level averages. Note that there are 20 independent observations per comparison.

SUPPLEMENTARY MATERIALS: FOR ONLINE PUBLICATION ONLY

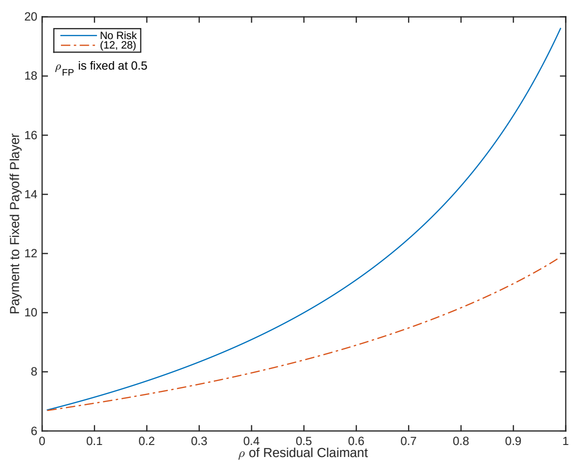
Contents

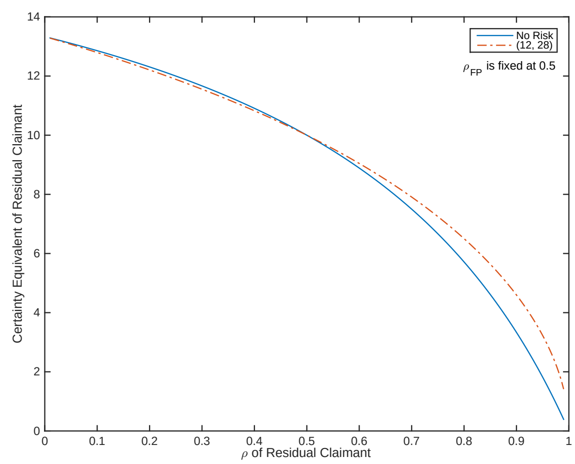
B More Theoretical Background

B.1 Illustrating the Benchmark Mechanism

Figure B.1 provides an illustration of the benchmark Hypotheses 1–3. It considers the case where both players have, commonly known, CRRA preferences, with the FP player's risk aversion parameter fixed to $1/2$. The left-hand panel graphs the predicted payment for the FP player, and the right-hand panel the certainty equivalent of this agreement for the residual claimant, as a function of the risk aversion parameter for the residual claimant (ρ_{RC}). The graphs show this for two pie-distributions: no risk (solid blue line) and $(12, 28)$ (red broken line). In Figure B.1(a), the payment to the fixed-payoff player when there is no risk is higher than the payment when there is risk for all values of ρ_{RC}, which demonstrates Hypothesis 1. Furthermore, both lines are increasing in ρ_{RC}, which is the comparative static of Hypothesis 2 for the residual claimant's degree of risk aversion.

Figure B.1: Example of Payment to FP Player and Certainty Equivalent for RC Player





Note: These figures are drawn under the assumption that players have, commonly known, CRRA utility functions.

Hypothesis 3 can be seen in Figure B.1(b), in particular for the identity of the residual claimants predicted to benefit from their exposure to risk. For **fixed** risk preferences of the players, if the dashed red line is above the solid blue line then the residual claimant has a higher expected utility at the predicted agreement under the risky pie-distribution than under the riskless pie-distribution. As can be seen, this is the case for, approximately, $\rho_{RC} > 1/2 = \rho_{FP}$.

B.2 Adapting the Bolton and Karagözoğlu (2016) Fairness-Adjusted NBS to the Residual Claimant Setting

Bolton and Karagözoğlu (2016) consider a social preference modification of the Nash bargaining solution in an environment with two clear competing fairness ideas. The majority of players are modeled as compromising types, which would prefer more surplus to less, so long as they receive as least as much as they would receive from the fairness idea that the other player prefers; otherwise, they prefer disagreement. There is also a small chance of meeting a non-compromising type that would prefer disagreement to any allocation that does not give them at least as much as their preferred fairness idea.

When two compromising types meet, the predicted outcome is determined via the standard Nash bargaining calculus—that is, it depends on the preferences of the two players and is found by balancing their boldness—except with the disagreement points adjusted to exclude agreements that do not lie between the competing bargaining fairness ideas.[30] Thus, compromising players negotiate as if, in the face of impasse, they could always offer the other player's self-serving fairness idea to avoid outright disagreement. Using the notation from the main text, the fairness-adjusted NBS would select the $y \in [y^f_{RC}(\pi), y^f_{FP}(\pi)]$ that maximizes the fairness-adjusted Nash product:

$$\left[u_{FP}(y) - \tilde{d}^{\pi}_{FP}\right] \cdot \mathbb{E}_{\pi}\left[u_{RC}(\pi - y) - \tilde{d}^{\pi}_{RC}\right].$$

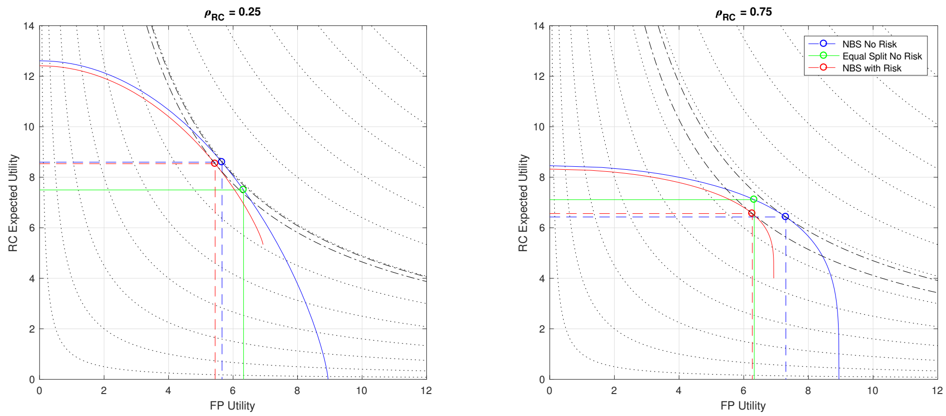
In the case of risk—and in contrast to the environment implemented in Bolton and Karagözoğlu (2016)—the fairness idea for the one player, the residual claimant, is less transparent than it is for the other, the fixed payoff player. While it is clear it would involve some compensation for their exposure to risk, it is not clear what would be a sufficient compensation to guarantee agreement with a non-compromising type. We consider two possible empirical strategies for determining this fairness idea. The first uses the fairness assessments by residual claimants, and takes the fairness idea to be the minimum fairness assessment for the associated pie-distribution. This approach leads y^f_{RC} to be 8, 8, 6, and 6 for the (16,20,24), (16,24), (12,20,28) and (12,28) pie-distributions, respectively. These values imply a very strong bargaining position for the residual claimants, to the extent that, for example, all residual claimants with a CRRA coefficient in $[0, 1)$ would be predicted to do better in expected utility terms bargaining over the (16,20,24) pie distribution rather than the (20) pie-distribution. Given that the observed riskier choice rate is much lower than this, a second approach estimates the associated fairness idea by matching the predicted riskier choice rate with that actually observed in the endogenous design sessions.[31] This approach leads

[30] Boldness, or tolerance for risking impasse, is defined here as $\frac{u'(x)}{u(x)-u(d)}$. See Roth (1989) for an exposition of the important role played by boldness in the predictions of standard bargaining models. Indeed, the welfare result of White (2008) for the case of Nash bargaining is found by ensuring that the residual claimant's boldness is still as least as large as that of the fixed payoff player after the division has been adjusted to just compensate the residual claimant for their risk exposure.

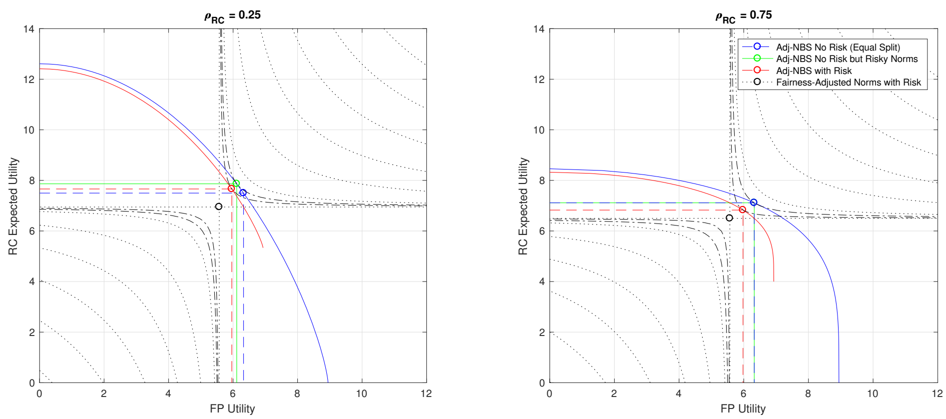
[31] Note that some of this discrepancy could be explained by the increased disagreement rate observed both in the more risky pie-distributions, as well as after the more risky distribution has been chosen.

Figure B.2: A Comparison of the Standard and Fairness-Adjusted Nash Bargaining Solutions: Certain (20) versus the Riskiest (12, 28) Pie-Distribution.

(a) Benchmark Nash Bargaining Solution



(b) Fairness-Adjusted Nash Bargaining Solution



Note: These figures are drawn under the assumption that players have, commonly known, CRRA utility functions. In all cases, the FP player has a CRRA risk aversion coefficient of 1/2. In the left-hand figures, the residual claimant is less risk averse, with a CRRA risk parameter of 1/4; in the right-hand figures, the residual claimant is more risk averse, with a CRRA risk parameter of 3/4. The blue curve shows the Pareto frontier of possible agreed FP payments, and corresponding solution, for the certain pie-distribution; the red curve shows it for the risky pie-distribution. In the top figures, the green point indicates the $50-50$ split for the certain pie-distribution. In the bottom figures, the green point shows the solution for the counterfactual case where the disagreement point is moved from the binding $50-50$ allocation to the fairness ideas associated to the risky pie-distribution, but the Pareto frontier is kept the same as in the certain pie-distribution. For the fairness-adjusted cases, the ideas are the $50-50$ demand by the FP player for both pie-distributions, and the $50-50$ demand by the RC player for the certain pie-distribution and the empirically fitted fairness idea for residual claimants for risky pie-distributions. This latter fairness idea is found by matching the predicted and actual rates of riskier choice in the endogenous design when the RC is presented with a choice between the certain pie-distribution and the risky pie-distribution.

y^f_{RC} to be 9.52, 9.49, 8.26, and 7.76 for the (16,20,24), (16,24), (12,20,28) and (12,28) pie-distributions, respectively. We use these latter estimates in the following illustrations.

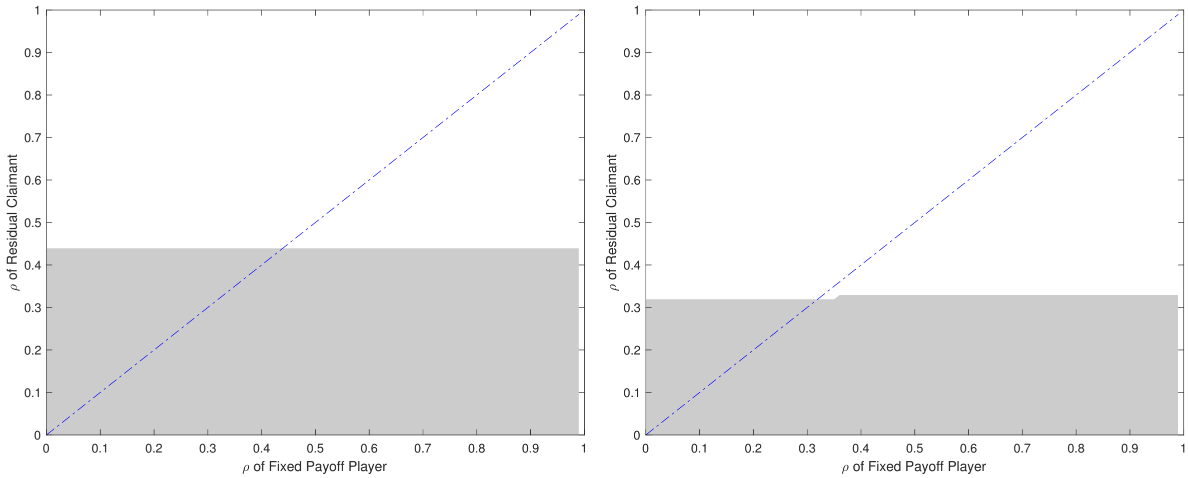
Figure B.2 illustrates the NBS for the benchmark (top) and fairness-adjusted models (bottom). As in Figure B.1 the FP player has CRRA preferences with risk parameter 1/2 in all cases. In the left-hand figures, the residual claimant is less risk averse, with a CRRA risk parameter of 1/4; in the right-hand figures, the residual claimant is more risk averse, with a CRRA risk parameter of 3/4. The top two graphs illustrate the benchmark mechanism. In the left-hand of the two, the residual claimant is less risk averse than the fixed payoff player they are matched with. Without risk, the residual claimant does better than the 50-50 split, and the reduction in the FP payment that comes with the addition of risk is not enough to make the residual claimant's expected utility higher under risk compared to the certain pie-distribution. In the right-hand graph, the residual claimant is more risk averse then the FP player, and does worse than the 50-50 split in the case without risk. Consequently, there is more room to secure a larger reduction in the agreed payment when risk is added to the pie-distribution, and the subsequent agreement gives the RC player a greater expected utility under the risky pie-distribution than under the certain pie-distribution.

The bottom two graphs illustrate the fairness-adjusted mechanism. This has two components: the change in effective disagreement points brought about by the change in fairness ideas between the certain and risky pie-distribution, and the prudence effect from the benchmark model. The former can be seen by comparing the blue solution point—which is the binding 50-50 solution—to the green solution point. The latter is a counter-factual bargaining solution where the Pareto frontier is unchanged, as if there were no risk added, but the fairness ideas are moved to those effective under risk. The change in fairness ideas opens up a region of the Pareto frontier over which the parties now bargain, and the less risk averse the residual claimant is, against a given FP player, the greater the share of the bargaining surplus they will be able to extract. This effect can be seen as the RC on the left-hand graph moves further away from the 50-50 solution than in the right-hand graph; indeed, the solution on the right-had side happens to approximately coincide with the 50-50 solution. The second, standard, effect is seen by comparing the green solution to the risky pie-distribution solution, the red line. Since both RCs in the green line are doing at least as well as the 50-50 split, it is no surprise to see that the benchmark, prudence-based, effect reduces the RCs welfare. The overall effect is the sum of these two, and in the case of the less risk averse residual claimant results in a greater welfare under risk, while for the more risk averse residual claimant their welfare is greater without risk. Thus, the combination of these two mechanisms reverses the predictions from the benchmark model.

Figure B.3 provides an analogy to Figure 2 by plotting in grey-shade the region of risk preference parameter values over which RCs are predicted under fairness-adjusted NBS to do better in expected utility terms for two pie-distributions used in the experiment: $(16, 20, 24)$, which is the least risky of the uncertain pie-distributions, and $(12, 28)$, which is the the most risky. As can be seen, in both cases it is the less risk averse RCs that are predicted to benefit from their exposure to risk. Furthermore, this prediction is less responsive to the risk attitude of the FP player than is the case in the benchmark model.

Figure B.3: Region over which Exposure to Risk is Advantageous for RC players—Fairness-Adjusted NBS Example

(a) (16, 20, 24) **(b)** (12, 28)



Note: In the grey region RC players are predicted to do better in expected utility terms. The broken 45-degree line indicates the locus for which the RC and FP players have identical risk preferences. These figures are drawn under the assumption that players have, commonly known, CRRA utility functions. For the fairness-adjusted cases, the fairness ideas are the $50-50$ demand by the FP player for both pie-distributions, The respective fairness ideas are a $50-50$ demand by the FP player, and the $50-50$ demand by the RC player for the certain pie-distribution and the empirically fitted fairness idas for residual claimants for risky pie-distributions. This latter fairness idea is found by matching the predicted and actual rates of riskier choice in the endogenous design when the RC is presented with a choice between the certain pie-distribution and the risky pie-distribution. Note that, if the RC player's fairness idea is taken to zero for the risky pie-distributions then all RCs are predicted to benefit in both pie-distributions.

B.3 Concession Process

The least willingness to face the risk of a conflict is measured by a players risk limit. Given two incompatible offers, $y_{RC}^k < y_{FP}^k$, this is given by

$$r_{RC} \quad = \quad \frac{\mathbb{E}_\pi\left[u_{RC}\left(\pi - y_{RC}^k\right)\right] - \mathbb{E}_\pi\left[u_{RC}\left(\pi - y_{FP}^k\right)\right]}{\mathbb{E}_\pi\left[u_{RC}\left(\pi - y_{RC}^k\right)\right] - d_{RC}}$$

$$r_{FP} \quad = \quad \frac{u_{FP}\left(y_{FP}^k\right) - u_{FP}\left(y_{RC}^k\right)}{u_{FP}\left(y_{FP}^k\right) - d_{FP}}$$

for the residual claimant and the fixed payoff player, respectively, where (d_{FP}, d_{RC}) equals $(u_{FP}(0), u_{RC}(0))$ in the case of standard Nash bargaining and $(\tilde{d}_{FP}^\pi, \tilde{d}_{RC}^\pi)$ in the case of fairness-adjusted Nash bargaining. The concession principle predicts that the player with the lower risk limit will make the next concession.

Suppose, without loss of generality, that $r_{FP} < r_{RC}$. Re-arranging the above expressions gives (see Harsanyi, 1977; Bolton and Karagözoğlu, 2016):

$$\begin{aligned} r_{FP} < r_{RC} \quad \Longleftrightarrow \quad & \left[u_{FP}\left(y_{FP}^k\right) - d_{FP}\right] \cdot \left[\mathbb{E}_\pi\left[u_{RC}\left(\pi - y_{FP}^k\right)\right] - d_{RC}\right] \\ & < \left[u_{FP}\left(y_{RC}^k\right) - d_{FP}\right] \cdot \left[\mathbb{E}_\pi\left[u_{RC}\left(\pi - y_{RC}^k\right)\right] - d_{RC}\right]. \end{aligned}$$

That is, the player predicted to concede next is the one whose open offer corresponds to the lower (fairness-adjusted) Nash product. Given a concession towards the other can only increase the Nash product of this player's subsequent offer, the (adjusted) Harsanyi-Zeuthen concession process would converge towards the (fairness-adjusted) Nash bargaining solution, which selects the feasible agreement with the highest such value.

While the original Harsanyi-Zeuthens framework envisioned bargaining parties with perfect information—specifically, that each party can estimate correctly the probability that the other party will definitely reject a certain offer (Harsanyi, 1956)—it is possible to view the concession principle as a (non-strategic) behavioral rule that defines a dynamic process that would converge to the (adjusted) NBS. Specifically, faced with incompatible open offers and the clock ticking, each party would hold out for as long as their risk tolerance dictates, making a small concession in the other's favour. Once one party has made a concession, the process would repeat itself, time permitting, until the parties have met somewhere in the middle. While this process is clearly non-strategic in nature, it does not require detailed knowledge of the other party's preferences to converge to the complete information (adjusted) NBS prediction, since each party's decision to concede during any interval of time is based only on their own risk tolerance and not on a direct comparison between each other's risk tolerance.

B.4 Private Information

The benchmark predictions are derived under the assumption that risk preferences are common knowledge. In the real world, as well as in the lab, risk preferences may be private information. Myerson (1979) provided a generalization of the Nash bargaining solution to the case where player may have private information on their type (e.g., risk preferences) drawing on insights from mechanism design.

Consider a simple environment in which the residual claimant has two possible types $\{\rho_1, \rho_2\}$, which correspond to different risk preferences, while the fixed payoff player has a single type denoted by ρ. We assume that ρ_2 is more risk averse than ρ_1 and that each possible type of the residual claimant is equally likely. Let $\mu : \{\rho_1, \rho_2\} \to [0,1] \times \Delta([0, \pi_{min}])$ denote a mechanism. In particular, $\mu(\cdot) = (d(\cdot), F(x|\cdot))$, where d is interpreted as the probability of disagreement and $F(x|\cdot)$ is a distribution over $[0, \pi_{min}]$. Let $U^r(\mu(\rho_i)|\rho_j)$ denote the expected utility of the type ρ_j residual claimant when he reports his type as ρ_i. Let $U^f(\mu) = (1/2)(U^f(\mu(\rho_1)) + U^f(\mu(\rho_2)))$ denote the fixed payoff player's expected utility from the mechanism. The generalized Nash bargaining solution is then the mechanism, μ^*, that maximizes:

$$(U^r(\mu(\rho_1)|\rho_1))^{0.5} \times (U^r(\mu(\rho_2)|\rho_2))^{0.5} \times \left(U^f(\mu)\right) \tag{1}$$

subject to:

$$U^r(\mu(\rho_1)|\rho_1) \geq U^r(\mu(\rho_2)|\rho_1)$$
$$U^r(\mu(\rho_2)|\rho_2) \geq U^r(\mu(\rho_1)|\rho_2).$$

That is, each type of residual claimant must find it in his interest to truthfully reveal his type. We do not need to worry about the individual rationality constraints, as they will be automatically satisfied given the constraint that an allocation, x, must be in $[0, \pi_{min}]$.

An Extension to Two FP Player Types. One can extend the generalized Nash bargaining solution to the case in which the fixed-payoff player has multiple types as well. We conducted a numerical exercise in which both players had two equally likely types: ρ_1^r and ρ_2^r for the residual claimant and ρ_1^f and ρ_2^f for the FP player. One is also free to make different assumptions about the relationship between the FP and RC players' type spaces. In our numerical analysis, below, we consider both the case in which type spaces may be different and one in which there is a single, common type space but that each player's realized type is drawn independently and with equal probability.

A Numerical Exercise. Given the non-linearity of the expected utility functions, it is analytically intractable to characterize the full set of incentive compatible mechanisms. Therefore, we focus our attention on three classes of mechanisms and—for the case of one FP Type—numerically optimize (1) over the set of incentive compatible mechanisms that fall into these three classes. The mechanisms are:

$$\begin{aligned}
\text{Pooling: } & \mu(\rho) = (0, x), \text{ where } x \in [0, \pi_{min}] \ \forall \rho \\
\text{Binary: } & \mu(\rho_1) = \begin{cases} (d_1, x_1), & \text{w.p. } p \\ (d_1, x_1'), & \text{w.p. } 1-p \end{cases} \quad \text{and } \mu(\rho_2) = (d_2, x_2) \\
\text{Uniform: } & \mu(\rho_1) = (d_1, \mathcal{U}[\bar{x}_1 - \nu, \bar{x}_1 + \nu]) \text{ and } \mu(\rho_2) = (d_2, x_2).
\end{aligned}$$

For the binary mechanism, we assume that $x_1 \leq x_1'$ and that $p \in [0, 1]$. A special case of this mechanism is when $p \in \{0, 1\}$ so that the outcome, conditional on an agreement being implemented is a deterministic function of the reported types. For the uniform mechanism, $\mathcal{U}[\bar{x}_1 - \nu, \bar{x}_1 + \nu]$ denote a uniform random variable with support $[\bar{x}_1 - \nu, \bar{x}_1 + \nu] \subseteq [0, \pi_{min}]$. Of course, when $\nu \to 0$, this also collapses to the special form of the binary mechanism. For the case in which the FP player has two types, we restricted attention to mechanisms of the form, $\mu(\rho_i^r, \rho_j^f) = (d_{ij}, x_{ij})$. That is, for each possible report, either a disagreement occurs or, if agreement occurs, the allocation is deterministic (but, potentially dependent on the reported types).

The pooling mechanism is a special mechanism in which the allocation is the same irrespective of the reported residual claimant type and, moreover, there is never disagreement. Such mechanisms are clearly incentive compatible and are also Pareto efficient since any change necessarily means allocating less to at least one residual claimant type or the fixed payoff player. The other mechanisms all include the possibility of disagreement and, at least for the less risk averse residual claimant, may introduce some degree of randomness to the allocation. This is done in order to prevent the more risk averse residual claimant from mim-

Table B.1: Who Benefits From Risk Exposure?

Risky Pie	Type Space	Which Residual Claimant Type Benefits From Risk			
		Low Type	High Type	Both Types	Neither Type
$(16, 24)$	2 RC, 1 FP	34.09	23.16	18.16	24.59
$(16, 24)$	2 RC, 2 FP (ind.)	44.73	16.66	23.00	15.62
$(16, 24)$	2 RC, 2 FP (com.)	65.83	30.33	0.06	3.78
$(12, 28)$	2 RC, 1 FP	37.93	13.17	24.66	24.24
$(12, 28)$	2 RC, 2 FP (ind.)	49.61	12.64	21.34	16.4
$(12, 28)$	2 RC, 2 FP (com.)	62.10	9.84	2.38	15.68

icking the less averse residual claimant. Such mechanisms may be incentive compatible and Pareto efficient.[32]

More specifically, we numerically solved (1) over the set of mechanisms as discussed above for a 50,000 draws of risk parameters, where each risk parameter, $\rho \in \{0, 0.01, \ldots, 0.99\}$. For the case of one FP type, this led to (ρ_1, ρ_2, ρ), where $\rho_1 < \rho_2$, while for the case of two FP types, this led to $(\rho_1^r, \rho_2^r, \rho_1^f, \rho_2^f)$, where $\rho_1^j < \rho_2^j$ for $j \in \{r, f\}$ and for the case of a common type distribution, this led to (ρ_1, ρ_2) where $\rho_1 < \rho_2$.

For the same set of risk parameters, we solved for the generalized Nash bargaining solution for three cases: (i) when the pie was riskless, (20), (ii) a risky pie with distribution $(16, 24)$ and (iii) a relatively more risky pie with distribution $(12, 28)$. These three distributions were each implemented in our experiment. Table B.1 provides the frequency that one, both or neither type of residual claimant benefits from risk exposure for each of the three settings we considered. As can be seen, the most common outcome is that only the less risk averse residual claimant benefits from risk exposure. In fact, the less risk averse residual claimant benefits from exposure to risk (either alone or together with the more risk averse residual claimant) over 60% of the time.

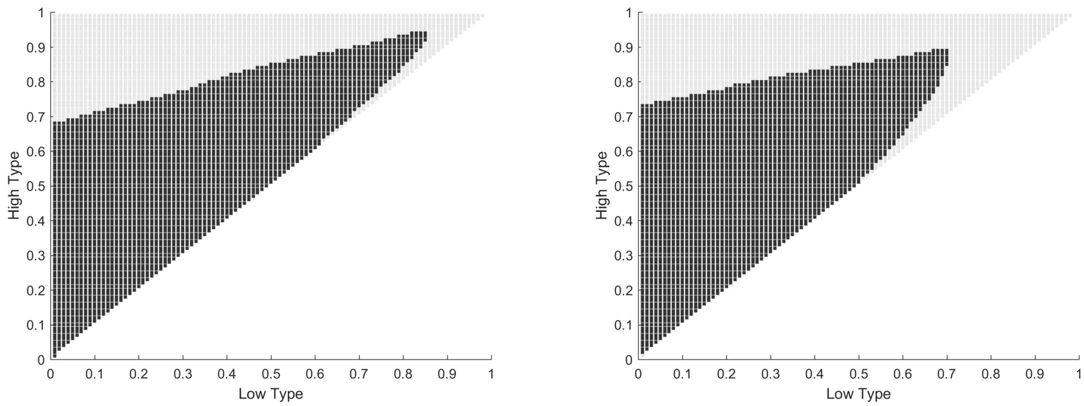
In addition to the summary results in Table B.1, Figure B.4 gives a visual depiction of the parameter values for which the less risk averse residual claimant benefits from risk exposure (the dark shaded region) for the case of a common type distribution. As can be seen, as long as the less risk averse residual claimant type is not, herself, too risk averse and as long as the more risk averse type is not too risk averse, then the less risk averse type benefits from exposure to risk.

This analysis suggests that an analog to Hypothesis 3 does not extend to the case of private information. Instead we summarize our discussion as follows:

[32]Note that we do not consider mechanisms in which the more risk averse residual claimant's payoff, upon a truthful report is random. Under the assumption of risk aversion of all player types, such mechanisms are unlikely to be Pareto efficient. A mean preserving reduction in variance would make both the more risk averse residual claimant and the fixed payoff player strictly better off. While such a change would also increase the temptation of the less risk averse residual claimant to misreport his type, one could simultaneously provide stronger incentives to this type to restore incentive compatibility while not hurting the other players relative to the initial mechanism.

Figure B.4: Regions Where Low Type Residual Claimant Prefers Risky Distribution

(a) Common Type Distribution; Pie is $(16, 24)$ **(b)** Common Type Distribution; Pie is $(12, 28)$



Note: The darker shaded region indicate the set of parameter types where the less risk averse type of residual claimant benefits from exposure to risk, while the lighter shaded region indicate the set of parameter types such that the less risk averse residual claimant suffers from exposure to risk.

SUMMARY 1 (WELFARE) *When risk preferences are private information, no definitive welfare conclusions can be made about exposure to ex post risk. Adding ex post risk may be either harmful or helpful to both the less and more risk averse residual claimant type. However, numerical analysis suggests that the less risk averse residual claimant type is more likely to benefit from risk exposure.*

Disagreement. We also analyzed disagreement rates, which may arise in the presence of private information based on the above numerical analysis. The results are in Table B.2. As can be seen, disagreements do occur but over all parameter combinations, they are relatively unlikely, unconditionally occurring less than 1% of the time. It turns out that, very often, given the risk parameters, the model does not predict any disagreement. What is more, we see that the disagreements become *less likely* as the pie over which subjects bargain becomes more risky, and this remains true if we condition on parameter values such that disagreement occurs with non negligible probability (i.e., > 0.001). That disagreement goes down as risk increases should be intuitive because the increase provides stronger incentives for the more risk averse type to truthfully reveal her type, meaning the chance of disagreement can go down when a player reports she is the less risk averse type.

Table B.2: Disagreement Rates Under Private Information

Distribution	2 RC, 1 FP	2 RC, 2 FP (ind.)	2 RC, 2 FP (com.)
(20)	0.37%	0.95%	0.89%
(16,24)	0.36%	0.76%	0.73%
(12,28)	0.01%	0.51%	0.48%

Summary 2 (Disagreement) *When risk preferences are private information, disagreement may occur as part of the solution to the generalized Nash bargaining solution. As the riskiness of the pie increases, disagreement does* not necessarily *become more likely.*

C Sample Instructions

C.1 Exogenous Design

General Instructions

Welcome

You are about to participate in a session on interactive decision-making. Thank you for agreeing to take part. The session should last about 90 minutes.

You should have already turned off all mobile phones, smart phones, mp3 players and all such devices by now. If not, please do so immediately. These devices must remain switched off throughout the session. Place them in your bag or on the floor besides you. Do not have them in your pocket or on the table in front of you.

The entire session, including all interaction between you and other participants, will take place through the computer. You are not allowed to talk or to communicate with other participants in any other way during the session. You are asked to follow these rules throughout the session. Should you fail to do so, we will have to exclude you from this (and future) session(s) and you will not receive any compensation for this session. We will start with a brief instruction period. Please read these instructions carefully. They are identical for all participants in this session with whom you will interact. If you have any questions about these instructions or at any other time during the experiment, then please raise your hand. One of the experimenters will come to answer your question.

Structure of the session

There are two parts to this session. Instructions for the part 1 are detailed below. Part 2 consists of survey and individual choice questions. Instructions for part 2 will be given once part 1 has been completed. Parts 1 and 2 are independent.

Compensation for participation in this session

You will be able to earn money for your decisions in both parts of this session. What you will earn from part 1 will depend on your decisions, the decisions of others and chance. Further details are given below. What you will earn from part 2 will only depend on your decisions and chance. Further details will be given after part 1 has been completed. In the instructions, and all decision tasks that follow, payoffs are reported in Euros (EUR). Your final payment will be 2 EUR plus the sum of your earnings from the two parts. Final payment takes place in cash at the end of the session. Your decisions and earnings in the session will remain anonymous.

Instructions for Part I

Structure of part 1

Part 1 is structured as follows:

1. At the beginning of part 1, you will be randomly assigned as either a type A or a type B participant. Your type will remain the same for the duration of part 1.

2. Part 1 consists of 10 periods.

3. At the beginning of a period, you will be randomly paired with another participant of a different type. That is, if you were assigned as type A, you will be randomly paired with a participant that was assigned as type B; if you were assigned as type B, you will be randomly paired with a participant assigned as type A.

4. This random pairing procedure is repeated at the beginning of every period.

5. During the period, you will interact only with the participant you have been paired with for that period. We refer to this participant as *your match*.

Description of a period

6. During a period you and your match will negotiate over how to divide between you an amount of money. We call the amount of money that you have to divide *the pie*. However, you will not always know size of the pie for sure. In some periods, there will be only one value that the pie could be (i.e. it is certain), in others there will be two values it could be – with each amount equally likely – and in others there will be three values it could be – again, with each amount equally likely.

7. At the beginning of the period, you and your match will be informed of the list of possible amounts for the pie. This list will vary from period to period. Neither you nor your match will know the actual size of the pie until end of the period. Only at this point will the size of the pie be determined: it will be randomly selected from the list of possible amounts.

8. You will decide on how to divide the pie by negotiating over the value (in Euros) of a fixed payment to the type A participant. These negotiations will take place through the computer interface. You will have 4 minutes in which to negotiate. The time limit is binding: if you and your match do not reach an agreement during this time limit you will both receive zero for the period.

9. During the negotiation time, you may make offers at any time. An offer is a suggested value for the fixed payment to the type A participant. *Note: If you are a type B participant, this will not be your payoff if the offer is accepted.*

10. The only restrictions on the offers you can make are: 1) the offer must be larger than zero, and 2) the offer must be less than the smallest possible value for the size of the pie. The computer interface will ensure these restrictions are met. Finally, only the *current offer*, that is the most recent offer made by a participant, can be accepted by the other participant.

11. An agreement is reached when either you or your match accept the other's current offer. Once an offer has been accepted, negotiations for the period end.

12. If you do agree on a value for the fixed payment, then the payoff in this period for the type A participant will be the agreed payment. The type B participant will receive whatever is left from the pie once the agreed payment has been subtracted. Consequently, if you reach an agreement, type A's payoff will always be certain, whereas type B's payoff will depend on the realised size of the pie.

13. A period is ended either by an agreement or by the elapse of the negotiating time limit.

At the end of a period

14. At the end of a period, the random pie size, your payoff for the period and that of your match will be determined and displayed.

The end of part 1

15. After a period is finished, you will be randomly paired for a new period. Part 1 consists of 10 such periods.

16. At the end of part 1 – that is, after the tenth period – one period will be selected at random. The payoff you gained during the selected period will be used to as your final payoff for part 1.

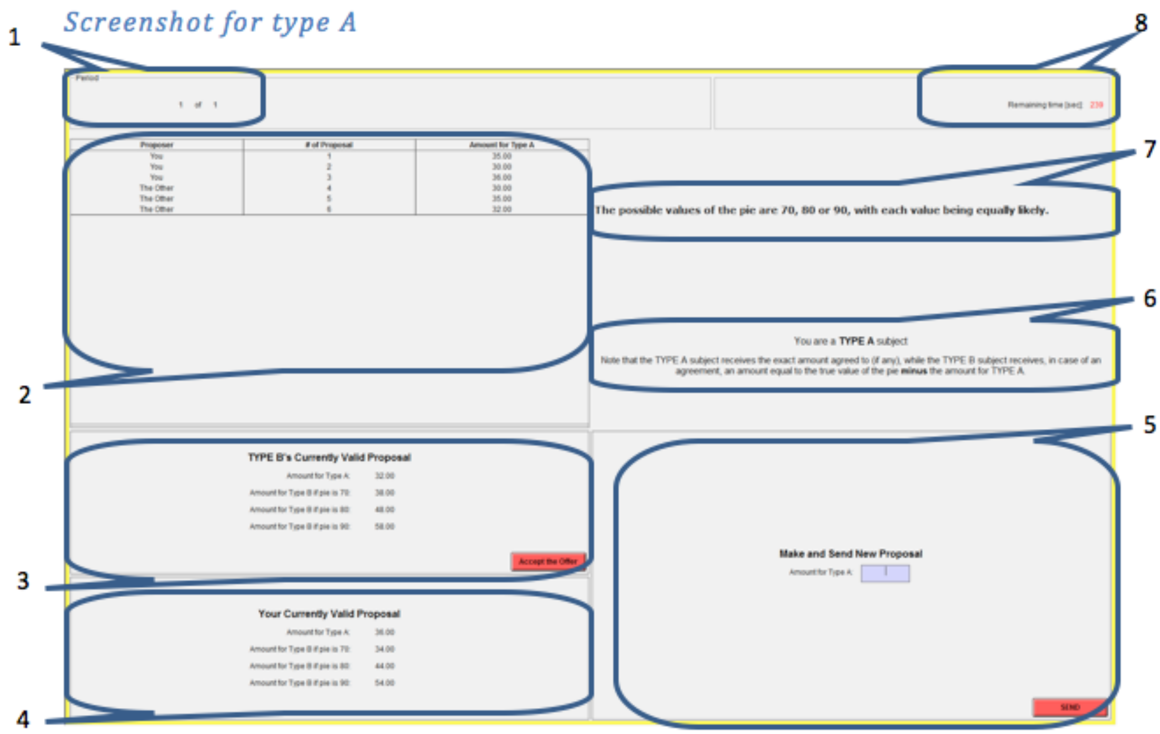
17. After your final payoff for part 1 has been calculated, the session will move on to part 2. Instructions for part 2 will be displayed on your computer terminal. Please read them carefully and proceed through part 2 at your own pace.

Making and Accepting Offers

An example

The following screen shot is used as an example to illustrate how you use the computer interface to make and accept offers. The screenshot shows the situation for a type A participant. The layout for a type B participant is analogous. For completeness, the associated screen for the type B participant is shown below.

Please note that the possible sizes of the pie, and the offers shown on the screen, are not values that you will see during the session itself. They have been selected for illustrative purposes only.



Key

1. *Period number box:* The number of the current period.

2. *Proposal history box:* This shows the history of offers you and your match have made.

3. *Your match's current offer box:* Details of the current offer made by your match. To accept their offer, click on the "Accept the Offer" button.

4. *Your current offer box:* Details of your current offer.

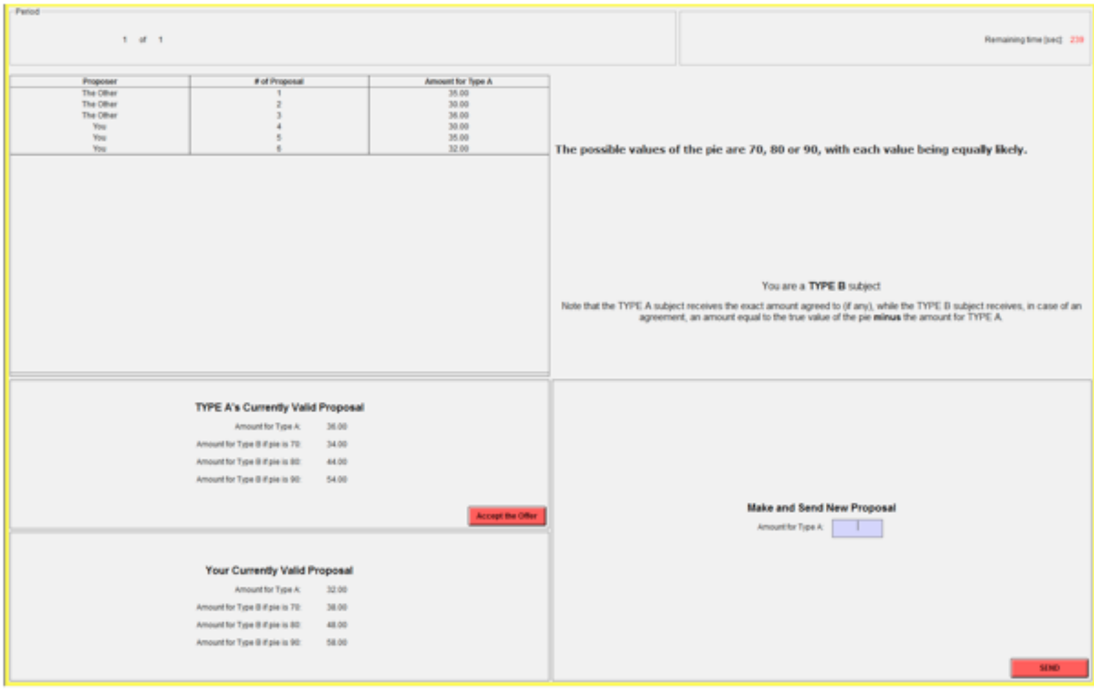
5. *New offer box:* To make a new offer enter a value for the fixed payment and click the "SEND" button.

6. *Type reminder box:* A reminder of your type and how your payoff for the period is calculated should you reach an agreement.

7. *Pie size reminder box:* A reminder of the possible sizes of the pie. Each amount is equally likely.

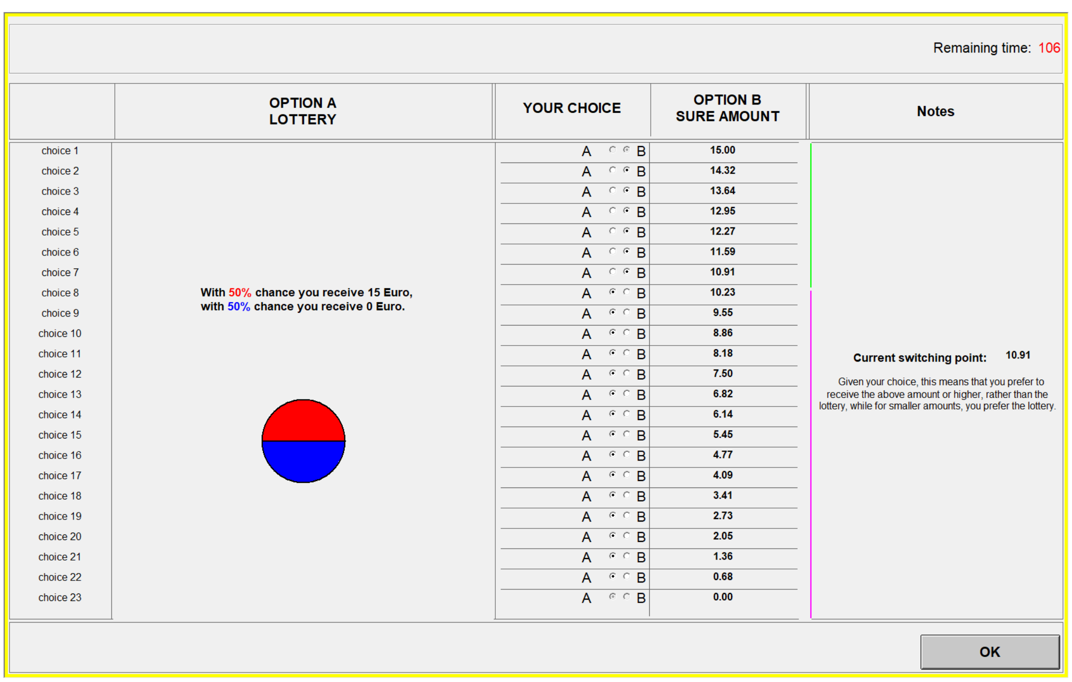
8. *Timer box:* The amount of time remaining.

Screenshot for type B



C.2 Decision Screen For Enhanced Risk Elicitation

Figure C.1: Decision Screen For Enhanced Risk Elicitaton



D Concession Predictions

This section provides the details for testing the concession predictions given in Hypotheses 5 and 5 (ALT), which are based on the HZ concession process. The HZ concession principle primarily makes predictions about the identity of the player making a subsequent concession, rather than whether there is a stand off or whether the subsequent standoff ends with a concession. Consequently, the analysis focusses on episodes where there are open and incompatible offers from both parties—what is referred to as a stand off—and one party subsequently concedes to the other. A concession can take the from of an acceptance of the other's offer, and the subsequent end of bargaining, or a new offer with terms more favourable to the other player but still incompatible with their current demand.

Subsection D.1 provides an overview of the data. Table D.1 gives a breakdown of the number of observations in each category across pie-distributions. Table D.2 gives a breakdown of the number of valid concessions for the benchmark, fairness-adjusted and alternative fairness-adjusted models (the fairness-adjusted and alternative fairness-adjusted model differ only in the way the fairness ideas for the RC player under risky pie-distributions are determined; see Section B.2 and below for more details). For the latter two, the risk limit definition is adapted to accommodate observations where one party makes an offer that violates the the assumed fairness ideas—i.e. the FP player makes a demand for more than 10, or the RC player makes an offer lower than their associated fairness idea. In the case where only one player violates the fairness idea, the risk limit of the other player is assigned to be 1.1 (i.e. strictly larger than 1), while the fairness-violating player's risk limit is calculated as normal. This ensures that the fairness-violating player is predicted to make the next concession. However, there is no particular prediction for the case where both players violate their respective (self-serving) fairness ideas, and such observations are dropped for the purpose of testing the fairness-adjusted models.

The hypotheses are tested via a series of regressions. In all cases the dependent variable is a simple indicator of whether the residual claimant was the one to concede. The independent variables of interests are indicator variables that indicate if the risk limit of the residual claimant is smaller than that of the fixed payoff player, and their interaction terms with other explanatory variables such as the riskiness of the pie-distribution, whether the pie-distribution was the riskier of the two possibilities in endogenous rounds, and whether the current stand-off was the last one before acceptance or disagreement.

The main regression specifications are reported in the main text. Section D.3 provides a series of additional analyses to support these conclusions. Table D.3 considers whether there is an important difference between concessions made during negotiations and the final concession (i.e. accepting the other's open offer). For both the benchmark and fairness-adjusted models this does not seem to be the case. Table D.3 also considers alternative models for unobserved heterogeneity by comparing the results from using subject level fixed effects to group specific fixed effects, as well as the case without any fixed effects. In both cases, adding controls for unobserved heterogeneity at either the subject or group level increases the size and significance of the risk limit variables. Table D.4 analyses further of the role of the pie-distribution risk. While the benchmark model is equally informative across the pie-distributions, the fairness-adjusted model makes better predictions in the risk-less and less risky distributions.

The fairness-adjusted prediction has some free parameters in that the fairness idea for the residual claimants in the case of risky pie-distributions is not fixed ex-ante. The predictions in the main text, as well as in Sections D.2 and D.3 pin down these free variables by matching the proportion of riskier choices from the endogenous design sessions (see Section B.2 for details). Section D.4 considers an alternative, which produces a greater distance between the self-serving fairness ideas of the RC and FP players to the (predicted) advantage of the former. These fairness ideas are found by using the reported fairness perceptions of RC players. The results are not qualitatively affected by this choice of RC fairness ideas.

D.1 Concessions Data

Table D.1: Summary of Raw Concession Data

Pie-Distribution	No Concession	Concession by FP	Concession by RC	Not a Standoff	Total
	All Offers				
(20)	479	215	248	235	1177
(16,20,24)	884	474	471	194	2023
(16,24)	1314	487	516	180	2497
(12,20,28)	1390	437	487	187	2501
(12,28)	965	408	504	182	2059
Total	5032	2021	2226	978	10257
	Last Offers				
(20)	4	40	37	74	155
(16,20,24)	9	60	69	20	158
(16,24)	14	72	60	10	156
(12,20,28)	15	61	58	17	151
(12,28)	15	57	67	14	153
Total	57	290	291	135	773

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players.

Table D.2: Summary of Concession Data for Benchmark and Fairness-Adjusted Models

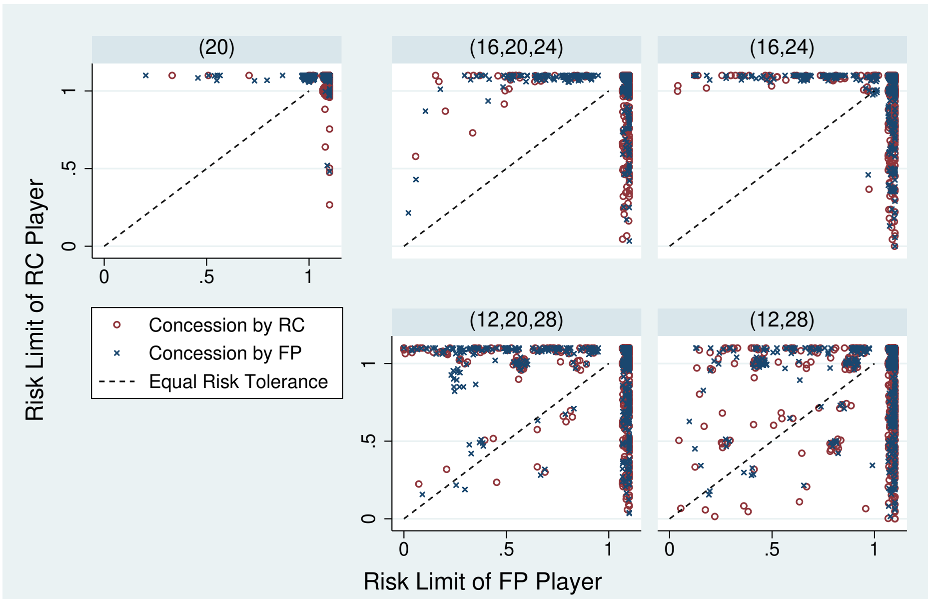
	Benchmark Model			Fairness-Adjusted Model			Alternate RC Fairness Ideas		
Pie-Distribution	FP	RC	Total	FP	RC	Total	FP	RC	Total
	All Concessions								
(20)	256	207	463	98	106	204	98	106	204
(16,20,24)	363	582	945	136	263	399	522	142	664
(16,24)	405	598	1003	179	348	527	535	229	764
(12,20,28)	398	526	924	247	387	634	643	193	836
(12,28)	330	582	912	241	450	691	514	302	816
Total	1752	2495	4247	901	1554	2455	2312	972	3284
	Last Concessions								
(20)	37	40	77	36	38	74	36	38	74
(16,20,24)	41	88	129	44	73	117	107	21	128
(16,24)	50	82	132	51	69	120	97	32	129
(12,20,28)	55	64	119	64	48	112	100	16	116
(12,28)	55	69	124	62	61	123	83	41	124
Total	238	343	581	257	289	546	423	148	571

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players.

D.2 Additional Figures

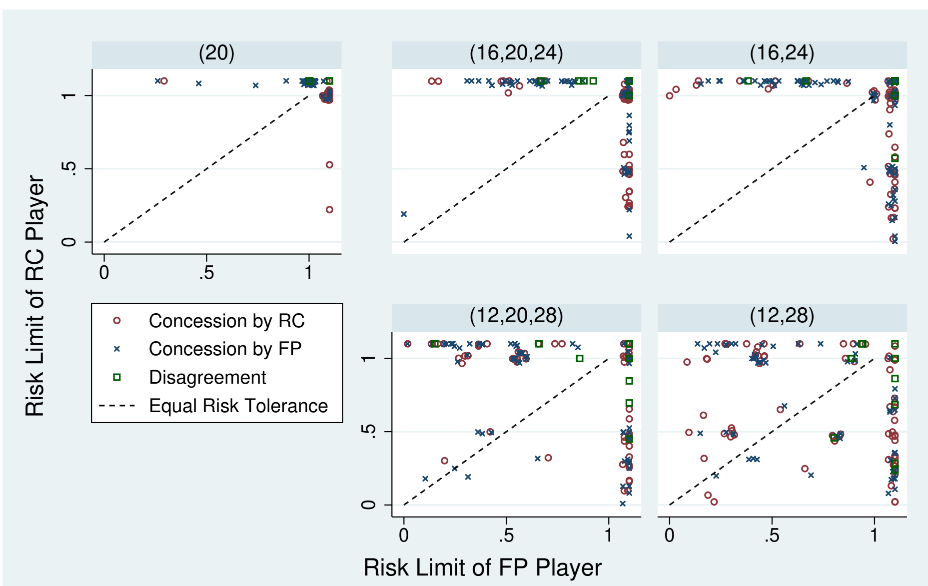
Figure D.1: Scatter Plot of Risk Limits for Fairness-Adjusted Model

(a) All Concessions



The RC is predicted to concede if their risk limit (RL) is lower than the FP, and vice−versa.
A risk limit of 1.1 indicates that the other player’s offer is less than the assoicated fairness norm.
Data uses all standoffs with a subsequent concession, and with ρ_{RC} and $\rho_{FP} \in [0,1)$.

(b) Final Concessions



The RC is predicted to concede if their risk limit (RL) is lower than the FP, and vice−versa.
A risk limit of 1.1 indicates that the other player’s offer is less than the assoicated fairness norm.
Data uses last offers with a standoff before an acceptance or the elapse of the bargaining time.
Data uses only observations with ρ_{RC} and $\rho_{FP} \in [0,1)$.

D.3 Further Regression Tables

Table D.3: Linear Regressions of RC Concession: Role of Last Offers Analysis and Modeling Unobserved Heterogeneity Analysis

	Benchmark Model			Fairness-Adjusted Model		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbf{1}[RL_{RC} \leq RL_{FP}]$	0.16^{***}	0.28^{***}	0.42^{***}			
	(0.000)	(0.000)	(0.000)			
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]$				0.30^{***}	0.42^{***}	0.54^{***}
				(0.000)	(0.000)	(0.000)
Last Offers	-0.05	-0.05	-0.06	-0.02	-0.02	0.03
	(0.121)	(0.124)	(0.121)	(0.389)	(0.578)	(0.253)
$\mathbf{1}[RL_{RC} \leq RL_{FP}]\times$(Last Offers)	0.04	0.06	0.06			
	(0.515)	(0.377)	(0.377)			
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]\times$(Last Offers)				0.00	-0.03	-0.13^{*}
				(0.948)	(0.590)	(0.060)
Constant	0.43^{***}	0.52^{***}	0.28^{***}	0.36^{***}	0.38^{***}	0.21^{***}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N. Obs	4241	4241	4241	2455	2455	2455
N. Pairs			655			602
N. Clusters	20	20	20	20	20	20
R^2	0.03	0.10	0.05	0.09	0.19	0.04

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level. Models (1) and (4) are simple linear regressions; models (2) and (5) include subject level fixed effects; models (3) and (6) include group level fixed effects.

Table D.4: Linear Regressions of RC Concession: Pie-Distribution Risk

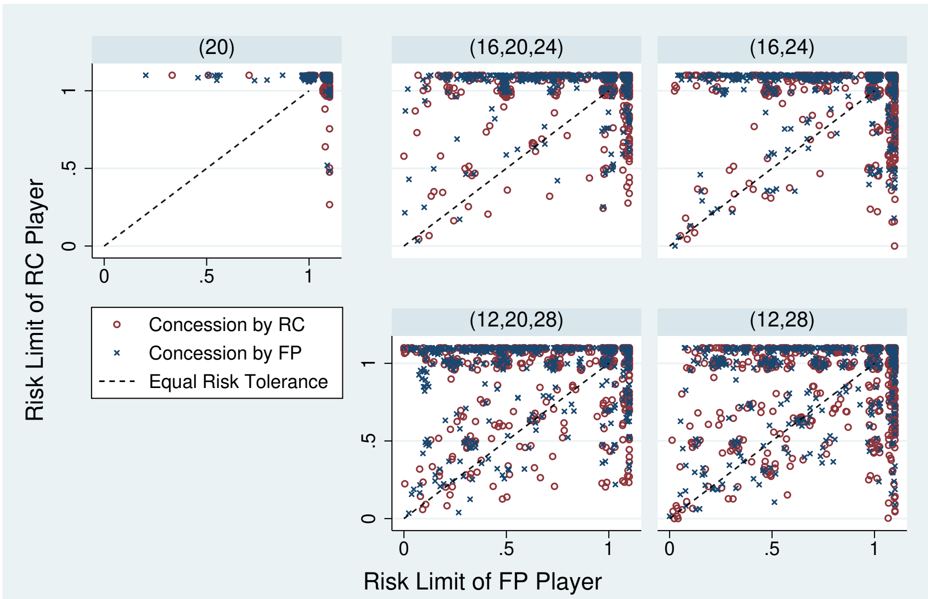
	Benchmark Model				Fairness-Adjusted Model			
	(1)		(2)		(3)		(4)	
$\mathbf{1}[RL_{RC} \leq RL_{FP}]$	0.35^{***}	(0.000)	0.35^{***}	(0.000)				
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]$					0.81^{***}	(0.000)	0.82^{***}	(0.000)
$\mathbf{1}[\text{Var.} > 0]$	0.01	(0.761)			0.22^{***}	(0.000)		
(16,20,24)			-0.05	(0.268)			0.11^{*}	(0.088)
(16,24)			0.03	(0.537)			0.20^{***}	(0.001)
(12,20,28)			0.01	(0.805)			0.23^{***}	(0.002)
(12,28)			0.08	(0.228)			0.33^{***}	(0.000)
$\mathbf{1}[RL_{RC} \leq RL_{FP}] \times \mathbf{1}[\text{Var.} > 0]$	-0.07	(0.117)						
$\mathbf{1}[RL_{RC} \leq RL_{FP}] \times (16,20,24)$			-0.02	(0.707)				
$\mathbf{1}[RL_{RC} \leq RL_{FP}] \times (16,24)$			-0.11^{*}	(0.055)				
$\mathbf{1}[RL_{RC} \leq RL_{FP}] \times (12,20,28)$			-0.04	(0.358)				
$\mathbf{1}[RL_{RC} \leq RL_{FP}] \times (12,28)$			-0.12^{*}	(0.072)				
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}] \times \mathbf{1}[\text{Var.} > 0]$					-0.44^{***}	(0.000)		
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}] \times (16,20,24)$							-0.31^{***}	(0.000)
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}] \times (16,24)$							-0.41^{***}	(0.000)
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}] \times (12,20,28)$							-0.45^{***}	(0.000)
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}] \times (12,28)$							-0.57^{***}	(0.000)
Constant	0.50^{***}	(0.000)	0.50^{***}	(0.000)	0.11^{**}	(0.038)	0.07	(0.217)
N. Obs	4241		4241		2455		2455	
N. Clusters	20		20		20		20	
R^2	0.10		0.10		0.20		0.20	

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level. All models include subject level fixed effects.

D.4 Alternative RC Fairness Ideas for Uncertain Pie-Distributions

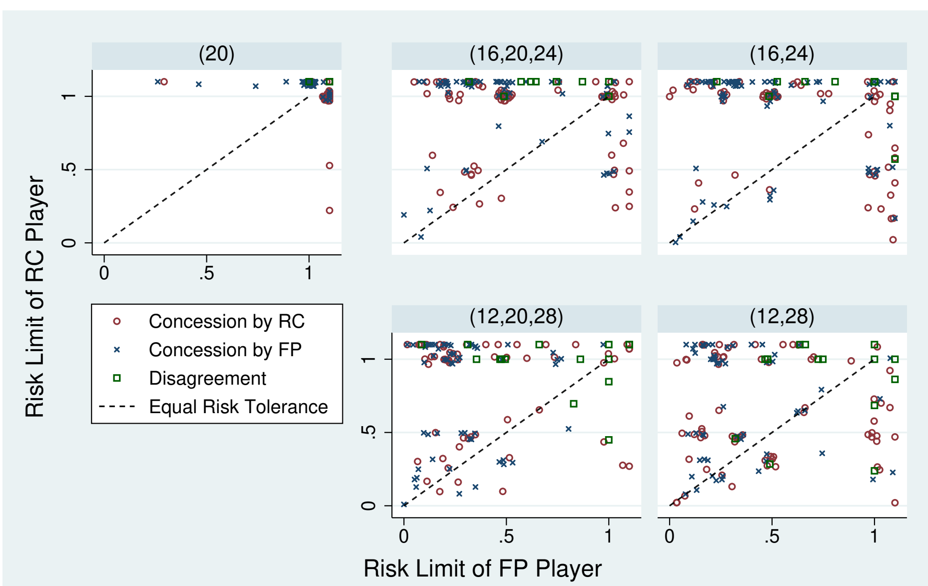
Figure D.2: Scatter Plot of Risk Limits for Alternative Set of Fairness Ideas

(a) All Concessions



The RC is predicted to concede if their risk limit (RL) is lower than the FP, and vice−versa.
A risk limit of 1.1 indicates that the other player's offer is less than the assoicated fairness norm.
Data uses all standoffs with a subsequent concession, and with ρ_{RC} and $\rho_{FP} \in [0,1)$.

(b) Final Concessions



The RC is predicted to concede if their risk limit (RL) is lower than the FP, and vice−versa.
A risk limit of 1.1 indicates that the other player's offer is less than the assoicated fairness norm.
Data uses last offers with a standoff before an acceptance or the elapse of the bargaining time.
Data uses only observations with ρ_{RC} and $\rho_{FP} \in [0,1)$.

Table D.5: Linear Regressions of RC Concession for the Fairness-Adjusted Model using an Alternative Set of RC Fairness ideas for the Risky Pie-Distributions: Main Regression Specifications and Horse-Race Regressions versus the Benchmark Model.

	Fairness-Adjusted Model		Benchmark vs. Fairness	
	(1)	(2)	(3)	(4)
$\mathbf{1}[RL_{RC} \leq RL_{FP}]$			0.09^{***} (0.001)	0.21^{***} (0.000)
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]$	0.25^{***} (0.000)	0.32^{***} (0.000)	0.21^{***} (0.000)	0.28^{***} (0.000)
Last Offers	0.00 (0.948)	-0.01 (0.636)	-0.04 (0.221)	-0.06^{*} (0.086)
$\mathbf{1}[RL_{RC} \leq RL_{FP}]\times$(Last Offers)			0.07 (0.223)	0.08 (0.220)
$\mathbf{1}[RL_{RC}^{adj} \leq RL_{FP}^{adj}]\times$(Last Offers)	-0.06 (0.333)	-0.04 (0.371)	-0.07 (0.205)	-0.05 (0.207)
Constant	0.45^{***} (0.000)	0.52^{***} (0.000)	0.40^{***} (0.000)	0.48^{***} (0.000)
N. Obs	3284	3284	3284	3284
N. Clusters	20	20	20	20
R^2	0.05	0.12	0.06	0.14

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level. All models include subject fixed effects. Models (1) and (3) a simple linear regressions; models (2) and (4) include subject level fixed effects.

E Additional Analysis of Process Data

E.1 Duration of Bargaining

To complete the picture of the bargaining process, we look at the determinants of bargaining duration. Table E.1 reports the results of a Weibull regression, where a player accepting an offer counts as a "failure" in the language of duration models. The regression includes a set of time-invariant explanatory variables, namely, the risk preferences of the FP and RC players, and an indicator variable for whether the pie is risky. In addition, the strength of bargaining conflict, measured as the difference between the standing offers of the FP and RC players at any point in time, is included. This is a time-varying coefficient. Note that a negative coefficient estimate means that the particular variable *increases* duration (i.e., bargaining takes longer), while positive coefficients mean that the variable decreases duration (i.e., bargaining ends sooner).

As can be seen from both estimated models, the amount of conflict has a strongly significant effect on duration. In particular, the stronger the conflict, the longer bargaining takes. Consistent with our descriptive results, bargaining also takes longer when the pie is risky. Interestingly, as can be seen from the second model, when the conflict variable is interacted with an indicator for risky pie-distributions, the primary effect of risk on duration is through bargaining conflict. That is, for a given amount of conflict in offers, it takes longer to bridge the gap if the pie is risky. Finally, we also see that risk preferences, for either player, do not appear to have a significant impact on duration, after controlling for bargaining conflict and whether or not the pie is risky.

Table E.1: Weibull Regression on Bargaining Duration

	Duration			
Conflict	-0.37^{***}	(0.037)	-0.24^{***}	(0.085)
$\mathbf{1}$[Var. > 0]	-0.63^{***}	(0.111)	-0.39^{*}	(0.200)
$\mathbf{1}$[Var. > 0] × Conflict			-0.15^{*}	(0.084)
ρ_{FP}	-0.06	(0.129)	-0.06	(0.135)
ρ_{RC}	0.02	(0.130)	-0.00	(0.127)
Constant	-8.18^{***}	(0.615)	-8.41^{***}	(0.653)
Log-Likelihood	-713.92		-710.53	
Observations	8613		8613	

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching-group level. In the Weibull regression, an acceptance is a "hit".

F Endogenous Design

In the *endogenous* design the residual claimant is asked to choose between two pie-distributions over which to bargain, after having gained some bargaining experience in an environment with exogenously given pie-distributions. The choice is always between two pie-distributions where one is a mean-preserving spread of the other. This addresses directly the welfare question since a choice of the riskier distribution reveals a preference to bargain over a riskier pie-distribution.

This section first outlines the design consideration and procedural details for the endogenous design. One of the treatment dimensions is a transparency condition (transparent RC choice versus non-transparent RC choice). The contrast between the transparent and non-transparent treatments can be used to establish whether being accountable for the choice of bargaining pie-distribution is a salient consideration for RC players (cf. Konow, 2000). Section F.2 provides details of the analysis of this contrast, and shows that transparency does not appear to be a salient concern. We subsequently pool the data. The analysis of RC's choice over which pie-distribution to bargain over is given in the main text. Section F.3 provides an analysis of bargaining outcomes in the first five periods, when the pie-distribution is exogenously given. Section F.4 provides details of the analysis of bargaining outcomes in the last five periods, when the RC is given some say over the pie-distribution that parties bargain over.

F.1 Design Considerations and Procedural Details

In the endogenous design, subjects first bargained for 5 rounds with exogenous pie-distributions, in which they experienced each pie-distribution once. In rounds 6–10, residual claimants were asked to choose between two pie-distributions before bargaining.

Given the five pie-distributions considered, we could create 10 possible pairs of pie-distributions for the residual claimant to choose from in the endogenous design. However, since we also wanted subjects to gain experience first with an exogenously given pie-distribution, it was not feasible to consider all 10 possible pairs in the same session. Therefore, we created two sets, called 'Low Risk' and 'High Risk' (see Figure F.1). In each set the RC player had the choice between distributions with the same general structure: (20) versus binary, (20) versus ternary, binary versus ternary (with the same extreme points), low risk binary versus high risk binary and low risk ternary versus high risk ternary. In the low risk set, the relatively less risky $(16, 24)$ and $(16, 20, 24)$ pie-distributions are used in the first three choices (rounds 6–8); in the high risk set, the relatively more risky $(12, 28)$ and $(12, 20, 28)$ pie-distributions are used in the first three choices (rounds 6–8). The remaining two distributions used in rounds 9–10 were the same in both the low and high risk set. In total we get data on 8 of the 10 possible binary choice sets, including all four of the more important ones: no risk versus some risk.

A large literature in behavioral economics emphasizes the role of fairness in bargaining, often based around fairness considerations and the role of intentions; that is, how kind other players' actions are perceived to be. Choosing the riskier distribution might be perceived as an unfair act by the RC (see, e.g., Cappelen et al., 2013; Cettolin and Tausch, 2015), and thus alter subsequent bargaining behavior. We, therefore, conducted two variations of the endogenous design treatments. In the first, the choice of the residual claimant is implemented for sure (transparent choice); in the second, the choice is implemented with probability 0.7 (non-transparent choice). The latter treatment masks intentionality by reducing the responsibility of the residual claimant in pie-distribution choice, which should increase the frequency with which residual claimants choose the riskier pie-distribution (Dana et al., 2007).[33] The complete 2×2 design is summarised in Figure F.1.

Figure F.1: Summary of the Treatment Variations for the Endogenous Design

	Transparent	Non-transparent
Low risk	(20) vs (16,24) (20) vs (16,20,24) (16,24) vs (16,20,24) (16,24) vs (12,28) (16,20,24) vs (12,20,28) Probability choice implemented =1	(20) vs (16,24) (20) vs (16,20,24) (16,24) vs (16,20,24) (16,24) vs (12,28) (16,20,24) vs (12,20,28) Probability choice implemented =0.7
High risk	(20) vs (12,28) (20) vs (12,20,28) (12,28) vs (12,20,28) (16,24) vs (12,28) (16,20,24) vs (12,20,28) Probability choice implemented =1	(20) vs (12,28) (20) vs (12,20,28) (12,28) vs (12,20,28) (16,24) vs (12,28) (16,20,24) vs (12,20,28) Probability choice implemented =0.7

192 subjects across eight experimental sessions for the endogenous pie-distribution design run in 2012 along with the original exogenous-only pie-distribution sessions. For the first five rounds, in the endogenous design the procedures were identical to the exogenous design: an FP player and an RC player bargained over an exogenously specified pie-distribution. In rounds 6 through 10 of the endogenous design, at the beginning of each round, the residual claimant was presented with a pair of possible pie-distributions and asked to choose one which would be implemented, either with certainty in the transparent choice sessions, or with probability 0.7 in the non-transparent choice treatment.[34] Details of the design are shown in Table F.1.

[33]Indeed, responses from our post-experiment survey from the exogenous design support the expectation that fixed-payoff players would be unwilling to compensate residual claimants for exposing the pair to greater risk. Three quotations expressing this view are: (1) "I would not accept less since I know [the residual claimant] took on more risks knowingly." (2) "I would kind of punish him for thanking [*sic*] this extra risk." (3) "If he had chosen over the certain outcome, I would pay a lower risk premium."

[34]The order of task was as in the original exogenous-only design: 10 bargaining rounds (B); incentivized risk elicitation (R); and *unincentivized* fairness elicitation (F). The order of uncertain pie-distributions in round 2-5 of the endogenous design sessions was (16,24), (12,28), (16,20,24) and (12,20,28). Subjects knew that in rounds 6-10 the RC player would make a choice before bargaining.

Table F.1: Details of Experimental Design for the Endogenous Design

Environment	Choice Set	Transparency	Sessions	Matching Groups	Subjects
Endogenous	Low Risk	Transparent	2	4	48
		Non-Transparent	2	4	48
	High Risk	Transparent	2	4	48
		Non-Transparent	2	4	48

F.2 Transparent versus Non-Transparent Choice

Despite our prior belief that the transparency of the choice of pie-distribution would affect the RC players' choice to bargain over the riskier pie-distribution, our analysis found no difference in behavior between the transparent and non-transparent choice treatments. For example, residual claimants are equally likely to choose the risky pie-distribution, and agreements and disagreements appear to be unaffected by this treatment variation. For this reason, and expositional ease, the main text pools the data across the transparent and non-transparent sessions. This subsection presents the data analysis for the transparent versus non-transparent contrast.

Table F.2 shows the proportion of RC players choosing the riskier distribution separately for the transparent-choice and non-transparent-choice conditions. Overall, transparency does not appear to be a salient concern. In particular, it is not the case that RC players under the non-transparent condition consistently choose the riskier distribution more often.

Table F.2: Percent of RCs Choosing Riskier Distribution by Transparency Condition (Periods 6-10) Including the TC versus NTC Contrast

	Transparent Choice			Non-Transparent Choice		
Alternatives	Low Risk	High Risk	Combined	Low Risk	High Risk	Combined
Certain versus Tertiary	58.3	41.7	50.0	45.8	62.5	54.2
Certain versus Binary	29.2	33.3	31.2	33.3	45.8	39.6
Tertiary versus Binary	37.5	20.8	29.2	25.0	29.2	27.1
(16,20,24) versus (12,20,28)	25.0	29.2	27.1	29.2	20.8	25.0
(16,24) versus (12,28)	37.5	8.3	22.9	37.5	16.7	27.1

This fact can be seen most easily by comparing specifications (1) and (2) of Table F.3, which runs a linear random-effect regression on a complete set of alternative dummies (the certain versus ternary alternative is the baseline of these regressions) separately for the transparent and non-transparent conditions. For either condition the main observations with respect to distribution choice from Section 4.2 hold: there is a general reluctance to choose the riskier of the two distributions with the certain versus ternary alternative being the notable exception, where around 50% of RCs choose the ternary alternative. The only effect of non-transparency appears to be a marginally significant increase in the proportion of RCs choosing the binary distributions over the certain distribution; there is no direct effect or interaction-with-ρ_{RC} effect—see specification (3).

Table F.3: Linear Random-Effects Regression of Choice of Distribution (Periods 6-10) Including the TC versus NTC Contrast

	Riskier Distribution Chosen		
	(1)	(2)	(3)
1[Certain versus Binary]	-0.25^{**} (0.105)	-0.07 (0.082)	
1[Tertiary versus Binary]	-0.20^{**} (0.094)	-0.24^{***} (0.089)	
1[(16,20,24) versus (12,20,28)]	-0.23^{***} (0.086)	-0.29^{***} (0.081)	
1[(16,24) versus (12,28)]	-0.28^{***} (0.095)	-0.27^{***} (0.085)	
1[Certain versus Tertiary]			0.25^{***} (0.049)
1[Certain verus Binary] × **1**[Non-Transparent]			0.19^{*} (0.105)
1[Non-Transparent]			-0.06 (0.076)
ρ_{RC}			-0.29^{***} (0.078)
ρ_{RC} × **1**[Non-Transparent]			0.13 (0.161)
Constant	0.51^{***} (0.055)	0.49^{***} (0.065)	0.34^{***} (0.049)
R^2	0.04	0.06	0.08
Observations	206	206	412
Transparency Condition	TC	NTC	—

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

Tables F.4 and F.5 investigate the bargaining outcomes after the distribution choice has been made. Again there is no overall consistent effect from making the distribution choice non-transparent. For agreed FP payments—Table F.4—the effect of risk and the role of the FP player's attitude towards risk show up more strongly in the non-transparent setting than the transparent one. However, the opposite is true for the role of the RC player's attitude towards risk.

For disagreements—Table F.5—there is a significant increase for both ternary distributions in the non-transparent setting; something that is not seen in the transparent setting and runs counter to the behavioural prediction that the non-transparent setting should mask intentions. However, much of the significant increases in disagreement rates in the non-transparent setting disappear once a dummy variable for whether the riskier of the two distributions was implemented is included, leaving just a large increase for the $(16, 20, 24)$.

F.3 Bargaining Outcomes in the First Five Periods

Table F.6 presents summary statistics, and Table F.7 complete pairwise comparisons across distributions, of the bargaining outcomes and fairness perceptions for the first five periods, when the distribution was exogenously specified. As can be seen these results reflect those for the exogenous design presented in Section 4.[35] In particular, agreed payments to FP

[35] There are two experimental implementation details that should be considered when comparing behavior from the early rounds of the endogenous design to the results from the exogenous design. First, the endogenous design does not vary across matching groups the order of presentation during the first five periods—doing so in a balanced way would have required twice as many matching groups in each cell of the 2×2 treatment

Table F.4: Linear Random-Effects Regressions of Agreed FP Payments in the Endogenous Design (Periods 6-10) Including the TC versus NTC Contrast

	Agreed FP Payments							
	(1)		(2)		(3)		(4)	
Variance	−1.03	(0.677)	-1.90^{***}	(0.593)	−0.66	(0.676)	-2.22^{**}	(0.958)
1[Riskier Dist.]	0.02	(0.364)	0.23	(0.414)	−0.05	(0.351)	0.28	(0.403)
ρ_{FP}					−0.47	(1.033)	-2.15^{***}	(0.638)
ρ_{RC}					0.54^{*}	(0.297)	−0.48	(0.957)
ρ_{RC} × Var.					-2.22^{***}	(0.633)	0.82	(1.599)
R^2	0.04		0.10		0.06		0.20	
Observations	189		182		189		182	
Transparency Condition	TC		NTC		TC		NTC	

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

Table F.5: Linear Random-Effects Regressions of Disagreements in the Endogenous Design (Periods 6-10) Including the TC versus NTC Contrast

	Disagreements							
	(1)		(2)		(3)		(4)	
$\mathbf{1}[(16, 20, 24)]$	0.07	(0.060)	0.19^{**}	(0.074)	0.05	(0.061)	0.17^{**}	(0.078)
$\mathbf{1}[(16, 24)]$	0.06	(0.055)	0.09^{**}	(0.037)	0.04	(0.051)	0.06	(0.042)
$\mathbf{1}[(12, 20, 28)]$	-0.04^{*}	(0.025)	0.13^{***}	(0.048)	-0.08^{*}	(0.045)	0.07	(0.046)
$\mathbf{1}[(12, 28)]$	0.17^{***}	(0.065)	0.07	(0.068)	0.10	(0.094)	−0.00	(0.089)
1[Riskier Dist.]					0.07	(0.062)	0.08^{*}	(0.041)
Constant	0.04^{*}	(0.025)	0.02	(0.024)	0.04^{*}	(0.025)	0.02	(0.024)
R^2	0.05		0.04		0.06		0.05	
Observations	206		206		206		206	
Transparency Condition	TC		NTC		TC		NTC	

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

players are significantly lower with risk, confirming Hypothesis 1. Furthermore, Hypothesis 4 is rejected: as the risk increases, the frequency of disagreements increases and significantly so for the two low risk distributions.

Table F.8 replicates the analysis of Table 3. With respect to Hypothesis 2, for a given distribution, agreed payments to FP players are decreasing in the FP's own risk aversion, consistent with the results from the exogenous design sessions. The coefficients for the RC player's risk aversion and its interaction with risk, however, are insignificant and of the wrong sign, although by the second half of the experiment these terms have the expected sign, even if the overall effect is still negative—see Table F.11 of the main text.

design, as well as requiring matching groups where the pie-distribution from period 5 featured in period 6. Consequently, for all matching groups of the endogenous design, $(16, 24)$ is the first pie-distribution that subjects experience with uncertainty. Second, in order for the experimental instructions to be as transparent as possible, subject were informed at the beginning of the session that the last five periods would include the endogenous choice stage.

Table F.6: Bargaining Outcomes and Fairness Perceptions in the Endogenous Design (Periods 1-5)

Distribution of Pie	Final FP Earnings (€)	Agreed FP Payments (€)	Disagreements (%)	Remaining Time (sec)	Fair Payment to FP: FP (€)	Fair Payment to FP: RC (€)
(20)	10.17 (3.24)	10.61 (2.50)	4.2 (20)	135 (88)	10.02 (0.25)	10.10 (1.07)
(16,20,24)	8.73 (3.44)	9.74 (1.79)	10.4 (31)	73 (86)	10.45 (1.62)	9.78 (1.76)
(16,24)	8.69 (3.84)	9.82 (2.34)	11.5 (32)	95 (80)	10.19 (1.27)	9.20 (1.28)
(12,20,28)	8.47 (2.79)	9.13 (1.50)	7.3 (26)	57 (79)	9.85 (1.45)	8.66 (1.94)
(12,28)	8.20 (3.03)	8.94 (1.81)	8.3 (28)	66 (77)	9.58 (1.61)	8.56 (1.91)

Notes: Standard deviations are reported in parentheses. The columns "Fair payment to FP" report the judgements of a fair allocation to the FP player. The first of these is the average allocation reported by those assigned the FP role; the second, the average reported by those assigned the RC role.

Table F.7: Pairwise Comparison of Bargaining Outcomes in the Endogenous Design (Periods 1-5)

	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)
	Final Earnings					*Agreed FP Payments*				
(20)	10.17	$>^{***}$	$>^{***}$	$>^{***}$	$>^{***}$	10.61	$>^{**}$	$>^{***}$	$>^{***}$	$>^{***}$
(16,20,24)		8.73	$>$	$>$	$>$		9.74	$<$	$>^{***}$	$>^{***}$
(16,24)			8.69	$>$	$>$			9.82	$>^{***}$	$>^{***}$
(12,20,28)				8.47	$>$				9.13	$>$
(12,28)					8.20					8.94
	Disagreements					*Time Remaining*				
(20)	4.2	$<^{**}$	$<^{**}$	$<$	$<$	135	$>^{***}$	$>^{***}$	$>^{***}$	$>^{***}$
(16,20,24)		10.4	$<$	$>$	$>$		73	$<^{**}$	$>$	$>$
(16,24)			11.5	$>$	$>$			95	$>^{***}$	$>^{**}$
(12,20,28)				7.3	$<$				57	$<$
(12,28)					8.3					66

Notes: The symbol indicates how the outcome measure of the row distribution compares (statistically) to the column distribution. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

Table F.8: Linear Random-Effects Regression of Agreed Payments to the FP Player in the Endogenous Design (Periods 1-5)

	Agreed FP Payments			
	(1)	(2)	(3)	(4)
$\mathbf{1}[(16,20,24)]$	-1.10^{***} (0.335)			
$\mathbf{1}[(16,24)]$	-0.85^{***} (0.285)			
$\mathbf{1}[(12,20,28)]$	-1.60^{***} (0.322)			
$\mathbf{1}[(12,28)]$	-1.64^{***} (0.347)			
Variance		-1.42^{***} (0.299)	-1.43^{***} (0.298)	-1.63^{***} (0.488)
ρ_{FP}			-1.12^{**} (0.520)	-1.14^{**} (0.538)
ρ_{RC}			-0.95^{**} (0.379)	-1.24 (0.811)
ρ_{RC} × Var.				0.64 (1.067)
Constant	10.78^{***} (0.301)	10.34^{***} (0.217)	11.05^{***} (0.323)	11.14^{***} (0.424)
R^2	0.09	0.06	0.10	0.11
Observations	378	378	378	378

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

F.4 Bargaining Outcomes in the Last Five Periods

This section focuses on Periods 6-10 of the endogenous design when the residual claimant could choose between a relatively less risky and a relatively more risky pie-distribution over which to bargain. A summary of the bargaining outcomes and fairness assessments can be found in Table F.9. For the most part, the observations from the exogenous design carry over to the endogenous one: final FP earnings and agreed FP payments are generally decreasing in the riskiness of the pie-distribution; bargaining over a risky pie-distribution results in more disagreements and longer bargaining duration; and agreed FP payments for risky pie-distributions tend to lie between the (self-serving) fairness assessments of the FP and RC players. Table F.10 gives for a complete set of pairwise comparisons across pie-distributions.

Regression analyses corroborate this impression. The first regression of Table F.11 shows that agreed FP payments are, in accordance with Hypothesis 1, (weakly) decreasing as risk increases. An analogous linear regression, specification (1), for disagreements establishes the significance of the increase in the frequency of disagreements for most risky pie-distributions, contrary to Hypothesis 4, but in line with Hypothesis 4 (Alt). The second specifications show that the riskier of the two pie-distributions being implemented does not have a significant bearing on agreed payments to the FP player, but does increase the likelihood of disagreement.[36] This suggests that choosing the riskier pie-distribution may have a cost that is not captured by the theoretical benchmark model, which assumes no disagreements. Finally, specification (3) establishes that the majority of the comparative statics from Hypothesis 2 carry over to the endogenous-distribution design. For a given pie-distribution, the direct effect of being more risk averse is a decrease in bargaining power (negative effect on payments for FP players; positive for RC players). For RCs, the interaction between variance and risk aversion improves their bargaining position. However, different from the exogenous design, the direct effect is smaller and the interaction effect larger, resulting in an overall effect for ρ_{RC} that is negative for risky pie-distributions. That is, more risk aversion improves the RC player's bargaining position, contrary to Hypothesis 2.

In summary, the main bargaining-outcomes results seen under the exogenous design are also observed in the pie-distribution choice setting. Residual claimants extract a risk premium for their exposure to risk and, all else equal, being more risk averse—at least for FP players—reduces a player's share of the surplus in an agreement. While choosing the riskier of two distributions does not appear to affect agreed payments to the FP player, it is associated with an increase in the likelihood of disagreement.

[36] In this case, the linear functional form gives a slightly larger disagreement effect: with either a logit or probit form the marginal effect is around 5.5%, and the significance between 5-7%.

Table F.9: Bargaining Outcomes and Fairness Ideas in the Endogenous Design (Periods 6-10)

Distribution of Pie	Final FP Earnings (€)	Agreed FP Payments (€)	Disagreements (%)	Remaining Time (sec)	Fairness Ideas (€ to FP) FP	RC
(20)	9.76 (2.53)	10.14 (1.67)	3.7 (19)	123 (101)	10.00 (0.00)	10.15 (1.40)
(16,20,24)	8.39 (3.92)	9.81 (1.99)	14.4 (35)	62 (80)	10.50 (1.48)	9.80 (1.73)
(16,24)	8.71 (3.58)	9.84 (1.81)	11.4 (32)	60 (82)	10.29 (1.28)	9.28 (1.35)
(12,20,28)	8.51 (2.91)	9.17 (1.75)	7.1 (26)	52 (77)	9.57 (1.53)	8.86 (1.83)
(12,28)	7.42 (3.23)	8.44 (1.77)	12.1 (33)	22 (51)	9.30 (1.54)	8.45 (1.97)

Notes: Standard deviations are reported in parentheses. The columns "Fair payment to FP" report the judgements of a fair allocation to the FP player. The first of these is the average allocation reported by those assigned the FP role; the second, the average reported by those assigned the RC role.

Table F.10: Pairwise Comparison of Bargaining Outcomes in the Endogenous Design (Periods 6-10)

	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)	(20)	(16,20,24)	(16,24)	(12,20,28)	(12,28)
	Final Earnings					*Agreed FP Payments*				
(20)	9.76	$>^{***}$	$>^{**}$	$>^{***}$	$>^{***}$	10.14	$>^{**}$	$>^{**}$	$>^{***}$	$>^{***}$
(16,20,24)		8.39	$<$	$<$	$>$		9.81	$<$	$>^{**}$	$>^{***}$
(16,24)			8.71	$>$	$>^{**}$			9.84	$>^{**}$	$>^{***}$
(12,20,28)				8.51	$>^{**}$				9.17	$>^{**}$
(12,28)					7.42					8.44
	Disagreements					*Time Remaining*				
(20)	3.7	$<^{**}$	$<^{**}$	$<$	$<^{**}$	123	$>^{***}$	$>^{***}$	$>^{***}$	$>^{***}$
(16,20,24)		14.4	$>$	$>$	$>$		62	$>$	$>$	$>^{**}$
(16,24)			11.4	$>$	$<$			60	$>$	$>^{***}$
(12,20,28)				7.1	$<$				52	$>^{***}$
(12,28)					12.1					22

Notes: The symbol indicates how the outcome measure of the row distribution compares (statistically) to the column distribution. ***1%, **5%, *10% significance using standard errors clustered at the matching group level.

Table F.11: Linear Random-Effects Regressions of Bargaining Outcomes in the Endogenous Design (Periods 6-10)

	Agreed FP Payments						Disagreements			
	(1)		(2)		(3)		(1)		(2)	
$\mathbf{1}[(16,20,24)]$	-0.39^{**}	(0.153)					0.12^{**}	(0.048)	0.11^{**}	(0.050)
$\mathbf{1}[(16,24)]$	-0.39^{**}	(0.197)					0.07^{**}	(0.033)	0.04	(0.034)
$\mathbf{1}[(12,20,28)]$	-0.90^{***}	(0.319)					0.04	(0.039)	-0.02	(0.043)
$\mathbf{1}[(12,28)]$	-1.47^{***}	(0.337)					0.10^{**}	(0.047)	0.03	(0.070)
Variance			-1.47^{***}	(0.447)	-0.96^{*}	(0.529)				
$\mathbf{1}$[Riskier Dist.]			0.09	(0.255)	0.04	(0.246)			0.08^{**}	(0.040)
ρ_{FP}					-1.35^{**}	(0.562)				
ρ_{RC}					0.28	(0.361)				
ρ_{RC} × Var.					-1.73^{**}	(0.731)				
Constant	10.22^{***}	(0.163)	10.17^{***}	(0.119)	10.59^{***}	(0.341)	0.03^{**}	(0.017)	0.03^{*}	(0.017)
R^2	0.07		0.07		0.11		0.02		0.04	
Observations	371		371		371		412		412	

Notes: Data includes only observations for which $|\rho_i| < 1$ for both RC and FP players. $^{***}1\%$, $^{**}5\%$, $^{*}10\%$ significance using standard errors clustered at the matching group level.