Dynamic Fairness in Repeated Bargaining with Risk

Kyle Hyndman*

November 17, 2022

Abstract

We study dynamic notions of fairness via an experiment of a two-round bilateral bargaining environment, where the payoff to one player is subject to ex-post risk, while the other player receives a fixed payment, effectively making the player exposed to risk a residual claimant. The ex-post risk not only provides substantive issues for bargaining parties to resolve in the experiment – i.e. what is a fair compensation for the exposure to risk – it also results in the endogenous formation of reference points for the second round due to ex post inequality after the realization of uncertainty in the first round. We find support for a "payback" hypothesis. That is, agreements in the second round significantly differ from the first round in a manner consistent with reducing the inequality that arose due to the initial pie realization.

JEL classification codes: C71, C92, D81

Keywords: Repeated Bargaining, Ex-post Risk, Dynamic Fairness

*Hyndman: Naveen Jindal School of Management, University of Texas at Dallas, 800 W. Campbell Rd (SM31), Richardson, TX 75080 (E-mail: KyleB.Hyndman@utdallas.edu; ORCID: 0000-0003-3666-8734).

1 Introduction

Many bargaining situations often involve risk and these risks may not be shared equally between the parties involved. Therefore, it may happen that what seemed like a fair agreement from an ex ante perspective turns out to be highly unequal from an ex post perspective. For a variety of reasons it may be difficult to renegotiate these past agreements. However, it is also the case that many relationships between parties are long-term in nature. Therefore, although it is not possible to renegotiate the "old" pie, it is common to negotiate the division of the "next" pie. A natural question that arises is, how does the realization of uncertainty – and resulting ex post inequality – from the first negotiation affect a subsequent negotiation? This paper focuses on just this question.

It is easy to think of two differing arguments for what is the "fair" thing to do. On the one hand, as long as the first negotiation was fair from an ex ante perspective, then the realization of uncertainty should have no impact on future negotiations, especially if the underlying risks have not changed. On the other hand, one could try to argue that it is fair to equalize payoffs over all periods. Therefore, the advantaged party at the end of the first negotiation should "pay back" their good fortune and accept a less advantageous agreement in the second negotiation. This is a dynamic notion of fairness which conditions on past realizations and seeks to compensate for the inequalities that arise. For short, we call this the payback hypothesis.

Of course, both of these fairness notions – the past is sunk, or payback – are potentially reasonable but they are certainly in conflict. Past research has shown that when there are conflicting ideas about what constitutes a fair allocation, people adopt the fairness idea that is advantageous to them (Gächter and Riedl, 2005; Karagözoğlu and Riedl, 2015; Bolton and Karagözoğlu, 2016). While we expect self-serving appeals to fairness, we believe that it is interesting to study whether or not one of the fairness notions has more salience in actual bargaining in a controlled environment.

A leading example of the type of interaction highlighted above is that between a union and firm. Typically, the union negotiates a fixed wage schedule for its members which the firm must pay to the workers for the duration of the contract. Therefore, the workers' earnings are typically not subject to risk. In contrast, the firm's profits are likely subject to risk resulting from uncertainty about demand for its product(s) or the cost of procuring other inputs such as raw materials or capital investments. At the same time, the relationship between the union and firm is not a one-shot interaction. Instead, at periodic intervals, they must negotiate a new contract that will govern their relationship going forward.

Indeed, we can use the the North American automobile industry's recent history to highlight the above tensions in real-world, high-stakes negotiations. During the financial crisis of 2008-2009, the American automakers either entered into bankruptcy (General Motors and Chrysler) or came close to it (Ford). Because of this, they were able to extract large cuts to both pay and benefits for their workers. However, in the following years, the carmakers were much more profitable than most anticipated. As several newspaper articles indicate, this has had a substantial effect on how the union contracts were renegotiated. For example, in Canada, "The auto makers' declarations offer a glimpse of their key goal in bargaining – holding down their hourly labour costs, one of the key fixed costs they can control ... That sets the stage for difficult bargaining, because the union is intent on raising wages and recovering some benefits they surrendered during the 2008-2009 auto crisis" (Keenan, 2012). This example highlights that the firms tried to maintain the wages that were agreed to in crisis times as a kind of "new normal", while the union sought payback given the companies' subsequently improved fortunes.

A similar story played out more recently in the United States between the carmakers and the union. In even more stark terms, speaking about the decision to reject the initial agreement reached between the United Auto Workers (U.A.W.) union and Fiat-Chrysler, one worker said, "I feel like the company has been extremely profitable, and because we made concessions when things were tight, we deserve fairness when things are good" (Chapman, 2015a).[1] Beyond this, there is also a sense that payback should be larger, the better that the advantaged party did in the initial interaction. In an article comparing the differences between General Motors' and Fiat-Chrysler's respective contract negotiations with the U.A.W.,

> *[General Motors] also reported this week that it had made a pretax profit of $8.3 billion in North America in the first nine months of the year.*
>
> *That solid footing could prove to be G.M.'s biggest bargaining challenge, experts said.*
>
> *'This is a company that just posted a very strong profitability,' Ms. Dziczek said. 'The company's just not in as precarious a position.' She added that could lead workers to expect G.M.'s contract to exceed Fiat Chrysler's* (Chapman, 2015b).

In order to gain insights into how asymmetric risk exposure and repeated interactions influence bargaining, we run a controlled human-subjects experiment. In the experiment, two players are paired together — one of whose payoff is subject to ex post risk, while the other is not. In each of two bargaining rounds, the pair must negotiate a fixed payment to be paid to the player whose payoff is not risky (the fixed-payoff player or FP player for short). At the end of the first period, the uncertainty over the size of the pie is resolved and players learn the payoffs of both players: the FP player receives the agreed amount, while the residual claimant (RC player) receives the realized value of the pie minus the payment to the FP player. With this information, they must then negotiate for a second time a fixed payoff to the FP player. In the second negotiation we impose more structure on bargaining in order to get cleaner data on their bargaining positions. Specifically, players first, and simultaneously, make proposals. If those proposals are compatible, then an agreement is reached immediately. If they are not compatible, then the negotiation proceeds to a concession stage. Specifically, at any moment, a player can either hold out or concede, thereby accepting the other player's proposal. Because of this, initial proposals are highly payoff relevant and should represent a subject's view of a credible bargaining position.

We document the following results. First, both the residual claimant and the FP player believe that payback is the fair way to divide the second round surplus. However, our second result is

[1] Another example comes from the subsequent negotiations with General Motors: "G.M. is more profitable than it's ever been ... We've been killing ourselves on the floor, while G.M.'s raking in billions. We need something better" (Chapman, 2015b).

that subjects stake out second round bargaining positions in a self-serving manner. For example, when the first round pie was low – meaning that inequality favors the FP player – FP players demand the same payment as they agreed to in the first round, while the residual claimants offer significantly less. Similarly, when the situation is reversed and the first round pie realization was high – favoring the residual claimant – now FP players demand significantly more than their agreed first round payoff, while residual claimants offer approximately the same as was agreed to in the first round. Thus players stake out status quo bargaining positions when they were advantaged in the first round and demand payback when they were disadvantaged in the first round.

Our third result is that agreements are generally supportive of our payback hypothesis. In particular, 65.7% of agreements in the second round are consistent with payback, while 11.9% have the same division in both rounds and (i.e., status quo) and another 22.4% of agreements inconsistent with either payback or the status quo. While payback is, directionally, the most common outcome, in terms of magnitude, it does not come close to equalizing the payoffs of the two players over the two rounds they interact. Given the agreement in the second round, in expectation, the player that was advantaged at the end of the first round is expected to maintain that advantage.

One other interesting result that we document is that there is a strongly negative relationship between the round two claim of the fixed payoff players and their level of risk aversion, which is consistent with risk aversion being disadvantageous in bargaining. However, we also document that such risk averse players are less likely to concede. That is, they make a relatively weak offer but then "stick to their guns". Despite this, the overall result is that the total payoff to the fixed payoff player over the two bargaining rounds is significantly negatively related to her level of risk aversion. This is part of a broader finding that concession behavior (i.e., who concedes) appears to be inconsistent with a mixed-strategy equilibrium. That is, the player with the higher predicted concession probability is not more likely to concede. Despite this, predicted concession probabilities are associated with disagreements and overall bargaining duration in a manner consistent with the mixed strategy equilibrium. However, the FP player's level of risk aversion is also highly predictive of both disagreement and duration.

The next section contains an overview of the literature, including some interesting work by Andreoni et al. (2020) and Trautmann and van de Kuilen (2016) on dynamic notions of fairness. In Section 3 we provide our experimental design and formally state our payback hypothesis. Section 4 provides results from the first bargaining round, while Section 5 gives results for the second bargaining round. Finally Section 6 provides some concluding remarks.

2 Related Literature

Our paper touches on two main streams of literature. The first is bargaining with ex post (and asymmetric exposure to) risk. From a theoretical perspective, White (2008) theoretically studies this problem in a one-shot bargaining environment. She provides relatively mild conditions under which the expected receipts of the party exposed to risk increase with a small increase in risk. Even more interestingly, she also provides conditions under which the residual claimant would actually *prefer* to bargain over a risky pie, rather than a riskless pie. The condition is essentially decreasing absolute risk aversion. Because of this, the marginal utility of the residual claimant is convex. Therefore, when a small risk is introduced, the expected marginal utility of an additional dollar is higher than the marginal utility of the expected value. In a bargaining environment, this effectively makes the residual claimant more patient, which increases her bargaining power and leads to higher welfare for the residual claimant.

Embrey et al. (2021) experimentally studied the role of asymmetric exposure to risk in a one-shot setting, testing the theory of White (2008). Their experiments verified that the payment to the fixed payoff player decreases (i.e., the expected receipts of the residual claimant increase) as the riskiness of the distribution increases. They also showed that in notable instances, some residual claimants did better in an expected utility sense when bargaining over a risky pie than when bargaining over a riskless pie. However, in contrast to the prediction, the residual claimants who benefited were the relatively less risk averse. Rather than the mechanism proposed by White (2008), they argue that the asymmetric exposure to risk creates a wedge between the fairness ideas of the two players, and that a model of fairness-driven bargaining explains the data better. The issue of asymmetric exposure to risk has also been studied experimentally in more specific settings. Hyndman (2021) studied how risk affects the problem of partnership dissolution. The key differences between that paper and ours are (i) they consider a one-shot environment, and (ii) the negotiation must endogenously decide which party will be subject to ex post risk, as well as the price that the buyer pays to the seller. However, like Embrey et al. (2021), this paper shows that risk-holders are generally compensated for risk and, in fact, a majority of subjects appear to prefer to be the risk holders. In an application to supply chain contracting, Davis and Hyndman (2019) studied how asymmetric exposure to risk – which arises naturally under certain common contracting mechanisms – affects bargaining. In contrast to the other papers, Davis and Hyndman (2019) show that risk-holders earn significantly less. This is because, in their paper, both the size and division of the pie are determined in the negotiation and the subjects appear to focus on a salient anchor which seems fair but does not adequately compensate the risk-holders for the risk they are exposed to.

The second literature that this paper touches on is that of fairness, with early formalizations by Fehr and Schmidt (1999) and Bolton and Ockenfels (2000). Specifically, we know that players will routinely reject offers which would lead to highly unequal payoffs (Camerer, 2003, Ch. 2). In more recent work, numerous studies have shown that the fairness ideas that subjects hold have a significant impact on bargaining (see e.g., Gächter and Riedl, 2005; Karagözoğlu and Riedl, 2015; Bolton and Karagözoğlu, 2016). Less is known about how risk impacts fairness, including the extent to which people evaluate fairness from an ex ante or ex post perspective (Saito, 2013). Indeed, one of the key results of Embrey et al. (2021) is to demonstrate that when there is asymmetric exposure to risk, the players have conflicting beliefs over what constitutes a fair division, depending on whether or not they are exposed to risk.

Two interesting papers, Andreoni et al. (2020) and Trautmann and van de Kuilen (2016), both touch on the dynamics of fairness. In the former paper, the key elements of the experiment are: (i) subjects are outside third parties; (ii) there is a \$10 prize to be awarded via lottery to one of two poor families; (iii) a computer has pre-allocated some lottery tickets to one or both of the families; and (iv) subjects observe this pre-allocation and must allocate the remaining lottery tickets to the families. In one treatment, the twist is that after (iv), the subject is told whether the winning lottery ticket is one of the tickets that she allocated or one of the tickets that the computer allocated. She is then given the option to redistribute the potentially winning lottery tickets amongst the two families. A common result is that in (iv) subjects distribute lottery tickets so that each family has the same chance of winning. However, once subjects learn which class of tickets (the computer's or her's) are potentially winning, the subject redistributes the tickets to again equalize the chance of winning.

In Trautmann and van de Kuilen (2016), pairs of subjects interact. There are two states of the world. In one state, an advantageous allocation to player 1 will be implemented if both players agree; in the other state, an advantageous allocation to player 2 will be implemented if both players agree. If players do not agree, then an inefficient but equal allocation will be implemented. The authors consider variations where players decide either before or after the state of the world is revealed. However, when deciding before, the state is revealed, they make separate acceptance decisions conditional on the state. Like Andreoni et al. (2020), they document a dynamic inconsistency in which, ex ante, players are willing to accept a disadvantageous outcome, but then, when given the chance to revise the decision, reject it ex post.

In some ways, ours is a temporally separated version of these papers. In the first bargaining round, subjects try to negotiate a division that is, ex ante, fair. However, rather than renegotiating the agreement after the resolution of uncertainty (which is effectively what happens in the aforementioned papers), subjects have the opportunity to negotiate a different division of a second pie. Thus, we are able to see dynamic notions of fairness play out in real time and also how these fairness ideas play out in a relevant bargaining framework.

3 Experimental Design

Our experiment took place in the BEElab at Maastricht University in June 2015. In total, 6 independent sessions were conducted, each with 10 subjects.[2] At the beginning of each session, subjects were assigned the role of either the residual claimant (RC) or the fixed payoff (FP) player, and subjects kept their role for the duration of the experiment. In each period of the experiment – of which there were 5 in total – a residual claimant and a fixed payoff player were matched together into a pairing. These players would then interact with each other for two rounds. In each round, players knew that the pie was equally likely to be ECU14 or ECU16, but the true size of the pie was unknown at the time of bargaining. The object of negotiation in each round was the amount to be paid to the FP player. If an agreement, x, was reached, then the FP player would receive x,

[2]Given that the first bargaining round was very similar to Embrey et al. (2021), this sample size was determined to be sufficient to detect differences (from the expected equal split) in round 1 bargaining. Then, given the risky nature of the pie, there would be substantial variation in realized round 1 payoffs, which would then allow us to test the hypotheses of interest. However, no formal power analysis was conducted prior to data collection.

while the RC player would receive the $\pi - x$, where $\pi \in \{14, 26\}$ was the realized size of the pie for that round. If an agreement was not reached in a round, then both players would receive 0 for that round. Note that the size of the pie in each round was independent across rounds and the total earnings – in ECU – in a period was the sum of earnings over the two rounds.

The protocol for bargaining was different for the two rounds. In the first round, we used an unstructured bargaining environment, which we felt would be most conducive to the players reaching an agreement, thus generating a distribution of payoffs that would most likely display inequality in earnings between the two players. In the second round, because we are interested in identifying bargaining positions, and how bargaining positions depend upon the distribution of payoffs at the end of round 1, we decided to employ a structured bargaining protocol.

Specifically, in the first bargaining round, each pair of subjects had 4 minutes to try to reach an agreement. They could send and receive offers in a completely unstructured manner. Bargaining would end when one of the players accepted the other's current proposal or with the elapse of 4 minutes. If an agreement was reached, then the agreement would be implemented and the value of the pie would be realized; if time expired without an agreement, both players would receive zero for the round. At the end of the round, subjects would learn about the realized value of the pie and their payoff. Note that, whether or not a pair reached an agreement in the first bargaining round, they would still proceed to the second bargaining round.

The structured bargaining environment for the second bargaining round within a period was similar to Embrey et al. (2015). Specifically, subjects would first simultaneously make a proposal, y_{FP} for the FP player and y_{RC} for the RC player. Like the first round, the proposals were framed as a payment for the FP player. When speaking generically, we will refer to these as *proposals*. When speaking of the FP player's proposal, we will often refer to it as a *claim*, while when speaking of the RC player's proposal, we will often refer to it as an *offer*. If these proposals were compatible (i.e., $y_{FP} \leq y_{RC}$), then bargaining would end immediately and the FP player would receive the average of the claims: $(y_{FP}+y_{RC})/2$. However, if the claims were incompatible, the round would continue to a concession stage. Specifically, time would start counting and at every instant, a player could choose to accept their partner's proposal, which would end the round, or to wait.

In order to induce a cost of delay, subjects were told that each second that elapsed, the round would terminate with a chance of 0.55%, which corresponds to an expected duration of three minutes.[3] From a design perspective, one issue is that this creates a censoring problem. For example, if bargaining terminates after 200 seconds, then all we know is that players were willing to wait *at least* 200 seconds. In order to alleviate this, we implemented a blocking design. Specifically, the experimental software would only check every 60 seconds to see if bargaining expired. Therefore, in the above example, the concession stage would continue until the earlier of 240 seconds or a player concedes to his/her opponent. Of course, if a player conceded after 200 seconds but before 240 seconds, then the players would be told that bargaining had expired and would receive no payment, but now we, as experimenters, know the true concession time of the player who conceded. This

[3] In contrast, Embrey et al. (2015) induced time pressure via a shrinking pie. We wanted to avoid this, because a shrinking pie would also mean changing risk exposure.

blocking design has been used in indefinitely repeated games with random termination to mitigate a similar censoring issue (see, e.g., Wilson and Wu, 2017; Fréchette and Yüksel, 2013).

At the beginning of each new period, subjects would be matched with another subject in the opposite role with whom they have never previously interacted. As noted, each session consisted of 10 subjects – five FP and five RC players – and the experiment consisted of five periods. Therefore, every FP player was paired with every other RC player in the experiment exactly once. At the end of the five periods, subjects completed an incentivized risk elicitation task where we employed multiple price lists to elicit certainty equivalents for six binary lotteries. Following the risk elicitation task, subjects completed a non-incentivized fairness elicitation. Specifically, following Babcock et al. (1995), subjects were asked: "For each of the following situations, what would be, in your opinion, a "**fair**" amount to give to the [fixed-payoff player] from the vantage point of a **non-involved neutral arbitrator**?" Subjects were then asked for their fairness amount for the round 1 bargaining and also for round 2 bargaining, conditional on each of the two possible pie realizations from round 1.

Subjects' final earnings were determined as follows: one bargaining period was randomly selected for payment. The exchange rate was ECU2 = €1. For the risk elicitation task, there was a 50% chance that subjects would receive a fixed payment of €4 and a 50% chance that one decision for one of the lotteries would be implemented for payment. Earnings for parts 1 and 2 would then be summed and an additional €2 show-up fee was given. On average, subjects earned €17.80 (min. €6.95, max. €33.90). The experimental software was programmed in zTree (Fischbacher, 2007) and subjects were recruited using the online recruitment software ORSEE (Greiner, 2015).

As we have discussed above, the main hypotheses that we seek to test are:

HYPOTHESIS 1 (SELF-SERVING CLAIMS) *Round 2 bargaining positions (i.e., initial proposals) will be self-serving. Specifically, the player with the higher payoff at the end of the first round will choose an initial proposal close to the status quo, while the player with the lower payoff at the end of the first round will choose an initial proposal that demands payback.*

HYPOTHESIS 2 (PAYBACK) *Second-round bargaining agreements are consistent with payback. That is, when the first-round pie was low – meaning FP players were advantaged – then FP players will earn less in the second round than when the first-round pie was high – meaning that residual claimants were advantaged.*

4 Results: First Bargaining Round

4.1 Descriptive Results

In Table 1 we provide summary statistics for the first round of bargaining, where subjects had four minutes to bargain in an unstructured manner. As can be seen, the average agreed payment to the FP player is 9.55, which falls in between the average fairness perceptions of the FP and RC players. This is quite common in many bargaining situations (see, e.g., Gächter and Riedl, 2005; Bolton and Karagözoğlu, 2016; Karagözoğlu and Riedl, 2015). The average agreed FP payoff, at 9.55, is significantly different from 10 (two-sided Wilcoxon sign-rank test, $p = 0.031$), which indicates that a residual claimants do extract a risk premium.[4]

Table 1: Summary of Outcomes in Round 1

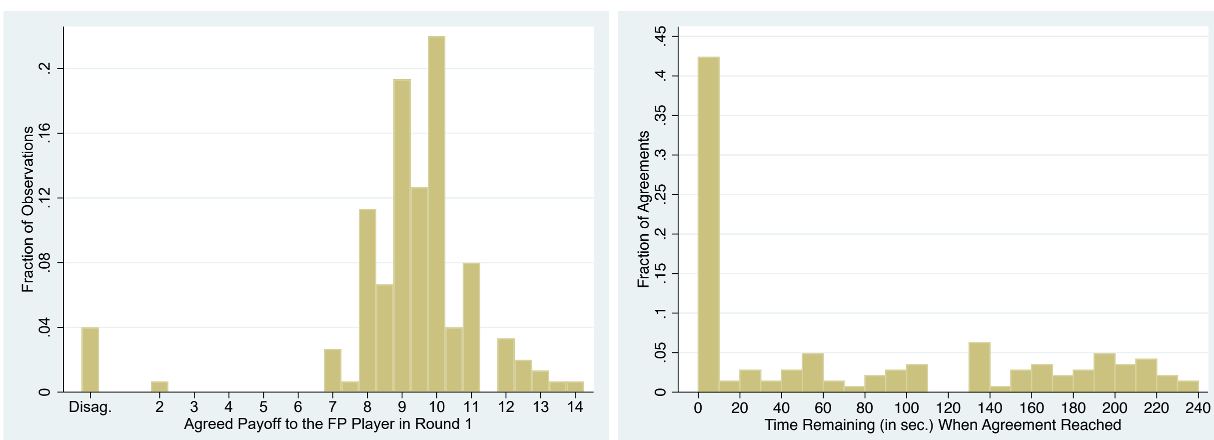
Outcome of Interest	Average	Std. Dev.
Agreed FP Payoff	9.55	1.446
Disagreement Rate (%)	4.00	0.196
Time Remaining at Agreement (sec)	77.38	82.05
Fairness Perception of FP Player	9.85	1.288
Fairness Perception of RC Player	9.00	1.211

Figure 1a shows the distribution of bargaining outcomes in round 1. The 50-50 split of the expected pie (i.e., 10 to the FP player) was the modal outcome, occurring 20.67% of the time, but the next three most common outcomes, 9, 8 and 9.5, all involved compensation for risk and also occurred relatively frequently: 15.33%, 10.67% and 8.67%, respectively. Only 20% of the time did the FP player receive strictly more than half of the expected round 1 pie.

Figure 1: Round 1 Bargaining Outcomes and the Timing of Agreements

(a) Empirical Distribution of Round 1 Outcomes

(b) Time of Agreement in Round 1



We also see that disagreement is fairly rare, occurring only 4% of the time. Finally, when an agreement is reached, on average, there was approximately 77 second left to negotiate. However, there is a great deal of variation behind this average. In Figure 1b we plot a histogram of the time at which agreements were reached in the first round of bargaining. While many studies on unstructured bargaining report strong deadline effects, it is even more pronounced here than usual. Over 40% of agreements take place in the last 10 seconds of bargaining; more strikingly, 35% of agreements are reached in the last **two** seconds. Of course, subjects knew that they would bargain

[4]We cannot compare this result with Embrey et al. (2021) because they did not implement the distribution used in our experiment. However, they consistently show that, in the presence of risk, the FP player typically earns significantly less than half the expected pie. Given the uni-directional nature of the hypothesis, we could also conduct a one-sided sign test. The $p-$value for this test is 0.016.

with the same opponent in a second round. Therefore, it seems is plausible that they wanted to show strength by holding out as long as possible – though this is cheap talk because there was no explicit cost of delay. Note also that the agreements do not appear to be strongly influenced by whether an agreement was reached at the deadline or not. Specifically, we cannot reject that the average agreed payoff to the FP player or the standard deviation of agreed payoffs are different depending on whether an agreement was reached in the last 10 seconds or an agreement was reached earlier (in both cases, $p \gg 0.1$). Thus, reputation-building seems to be the primary motivation for the strong deadline effect.

4.2 The Determinants of Round 1 Bargaining Outcomes

Table 2 looks at the determinants of round 1 agreed payoffs. The first three columns individually include opening offers – to test for anchoring (Galinsky and Mussweiler, 2001), risk preferences, and fairness considerations, while column (4) includes all variables. The risk preferences are estimated as the constant relative risk aversion (CRRA) parameter, ρ_i, that best-fits each subject's responses to the risk elicitation task after the main experiment.[5] As can be seen, the only variable that is significant is the opening offer of the fixed payoff player, which suggests that opening offers do have, at least partially, an anchoring effect.[6] In contrast to Embrey et al. (2021), risk preferences do not appear to have any influence on agreements, nor do fairness preferences. Both of these may be explained by a desire of players to hide their true nature (e.g., risk attitude) in order to appear stronger in the second round of bargaining.

Table 2: Determinants of Round 1 Agreements (FP Player's Payoff)

	(1)		(2)		(3)		(4)	
FP First Off.	0.347^{**}	(0.109)					0.341^{**}	(0.131)
RC First Off.	0.106	(0.088)					0.099	(0.078)
FP Risk Param.			−0.876	(0.939)			−0.593	(0.980)
RC Risk Param.			−0.305	(0.782)			−0.120	(0.513)
FP Fairness					0.016	(0.142)	0.123	(0.086)
RC Fairness					0.182	(0.150)	0.103	(0.143)
Constant	4.607^{*}	(1.797)	9.839^{**}	(0.354)	7.674^{**}	(2.271)	2.790^{*}	(1.181)
Observations	260		268		268		260	
R^2	0.15		0.03		0.02		0.18	

Notes: The dependent variable in all regressions is the payoff to the FP player, conditional on an agreement being reached. Additionally, the data includes only observations for which the players' estimated risk parameters, ρ_i, satisfied $|\rho_i| < 1$ for both RC and FP players. **1% and *5% significance using standard errors clustered at the matching group level.

Because we are primarily interested in round 1 only to generate ex post inequality going into

[5] Although not reported, we tested whether the elicited risk preferences differed by player role. Neither a Kolmogorov-Smirnov test, nor a rank-sum test is able to detect any differences in the distributions (in both cases $p > 0.2$). This suggests that players were appropriately randomized and that their experience as a particular role in the main experiment did not influence their risk attitudes.

[6] Whether the FP player was the first player in a pair to make an offer does not influence the agreements. In unreported regressions, the coefficient on such an indicator variable was never significant at conventional levels.

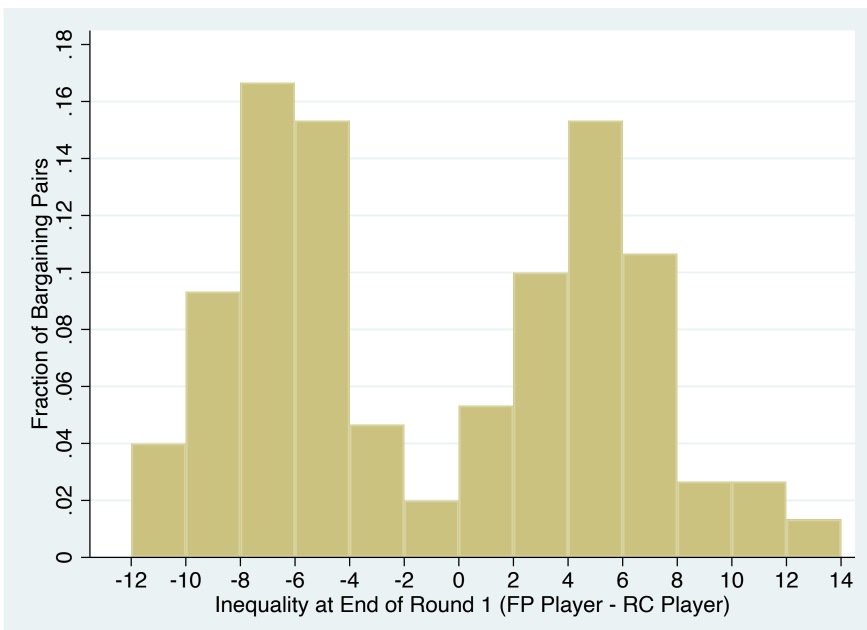
round 2, we do not spend time in the main text to provide more analysis. In Appendix A we do provide some detail on the determinants of disagreement. We summarize the results from the first bargaining round as follows:

Result 1 (Round 1 Bargaining) *Residual claimants are compensated for their risk exposure, with the average payment to the FP player being significantly less than 10. Agreements are subject to strong deadline effects and risk preferences do not appear to influence outcomes, suggesting that players try to use first-round bargaining to build a reputation.*

5 Results: Second Bargaining Round

In this section, we focus our attention on the second bargaining round and, in particular, testing our hypotheses. Before proceeding, we first show that, at the end of the first bargaining round, we successfully created a substantial amount of ex post inequality. This can be seen in Figure 2, which shows a histogram of the ex post inequality at the end of round 1. As can be seen, the distribution is bimodal – due to the realization of the round 1 pie – with modes at about -6 and 6.

Figure 2: Difference in Payoffs at the End of Round 1



5.1 Rates of Agreement and Disagreement

Table 3 reports the frequency of agreements and disagreements in round 2. As can be seen, 21.33% of bargaining pairs made compatible proposals in the initial stage of round 2. In these cases, bargaining ended immediately in agreement. In the remaining 78.67% of the cases, the players proceeded to a concession stage, where a player could only accept their match's proposal or wait, hoping for their match to accept their own proposal. Most of the time a valid agreement was reached within the time available for bargaining. The blocking procedure that we used to mitigate censoring due to random termination gave us 10% more uncensored data about concession times. In only 6.67% of the instances did the bargaining round terminate without an agreement.

Table 3: Classifying Round 2 Bargaining Outcomes

Outcome	Fraction of Observations
Compatible Proposals ($y_{FP} \leq y_{RC}$)	21.33%
Incompatible Claims ($y_{FP} > y_{RC}$)	
Valid Agreement	62.00%
Invalid Agreement	10.00%
No Agreement	6.67%
Total	100%

Note: To limit censoring of the data, we employed a blocking design in which the software would only check whether the bargaining time had expired every 60 seconds. For example, if the total time for bargaining was 70 seconds, then any agreement made at 70 seconds or before is "valid", while agreements made from 71 – 120 seconds would be considered "invalid" due to the lapse of bargaining time. If an agreement was still not reached after 120 seconds, then we classify these as "No Agreement".

We now dig a little deeper into agreements in round 2. We first seek to determine the characteristics which determine whether the round 2 proposals are compatible. For example, if both players are risk averse, then they may prefer to make a generous proposal in order to reduce the risk of disagreement. The results are displayed in the first column of Table 4.[7] It goes without saying that the higher is the FP player's claim the less likely are the proposals to be compatible and the higher is the RC player's offer, the more likely are the proposals to be compatible. However, we also see that the more risk averse the FP player, the more likely are the proposals to be compatible; as we will show subsequently, more risk averse FP players make weaker initial claims. Proposals are less likely to be compatible when the round 1 pie was high, which suggests that there is more conflict about what an acceptable agreement is in this situation.

In the second column we look at the likelihood of an agreement, conditional on incompatible initial proposals (i.e., the game proceeded to the concession stage).[8] Again, the sign and significance of the FP players' claims and RC players' offers are as expected. The most interesting result is that the more risk averse is the FP player, the less likely is there to be an agreement in the concession stage. As we will show later, this suggests that risk averse FP players, counterintuitively, stick to their guns in the concession stage. We also see that agreements are less likely in round 2 after an agreement in round 1. This likely indicates that those who failed to agree in round 1 were especially eager to agree in round 2 in order to not earn anything for that period.

We summarize the most important takeaway from this analysis as:

Result 2 *The likelihood of initial proposals being compatible is increasing in the risk aversion of*

[7] In Table B.1 we expand on the regressions reported here by including each variable group separately. The sign of all coefficients, when the variable is individually included is always the same as when all variables are included. The significance of a small number of coefficients is different.

[8] Below we will look again at agreements given incompatible claims, but through the lens of mixed strategy equilibrium predictions.

Table 4: The Determinants of Compatible Round 2 Proposals

	Compatible		Agree Given Incompatible	
FP Risk Param.	0.298^{**}	(0.066)	-0.199^{**}	(0.046)
RC Risk Param.	0.048	(0.045)	0.043	(0.135)
FP Claim	-0.138^{**}	(0.016)	-0.059^{**}	(0.021)
RC Offer	0.137^{**}	(0.018)	0.039	(0.023)
Round 1 Agree	0.117	(0.114)	-0.109^{**}	(0.027)
Round 1 Pie: 26	-0.118^{**}	(0.044)	0.071	(0.097)
Constant	0.339	(0.231)	1.336^{**}	(0.143)
Observations	280		216	
R^2	0.553		0.107	

Note 1: In the column, "Compatible", the dependent variable is an indicator variable which takes value 1 if the players' proposals were compatible. That is, $y_{FP} \leq y_{RC}$, and 0 otherwise. In the column, "Agree Given Incompatible", the dependent variable is an indicator variable which takes value 1 is the players reach an agreement in the concession stage. This regression, therefore, includes only those bargaining pairs for which their initial proposals were *incompatible*. We include only those observations for which the estimated risk parameters $|\rho_i| < 1$ for both players.

Note 2: **1% and *5% significance using standard errors clustered at the matching group level.

the FP player. However, if initial proposals are incompatible, then increased risk aversion by the FP player is associated with ***more*** *disagreement.*

5.2 Fairness Perceptions and Initial Bargaining Positions

In Table 5a we provide summary statistics for the fairness perceptions that we elicited, broken down by subject-role, while in Table 5b, we report the initial bargaining positions taken by each subject type and for each round 1 pie realization. Consider first the fairness perceptions. Note that for both the FP and RC players, the average fair allocation to the FP player following a low pie realization is significantly less than the average fair allocation in round 1 (for FP players 8.32 vs 9.85 and for RC players 7.75 vs 9.00; in both cases, a Wilcoxon sign-rank test strongly rejects equality at $p \ll 0.001$). Similarly, it is also the case that the average fair allocation to the FP player following a high pie realization is significantly higher than the average round 1 fair allocation (for FP players 10.95 vs 9.85 and for RC players 11.07 vs 9.00; in both cases $p \ll 0.001$ according to a Wilcoxon sign-rank test). Interestingly, the perceived fair allocations do not differ significantly between FP and RC players (following low pie realization: $p = 0.079$; following high pie realization: $p = 0.673$). This analysis shows that, in terms of fairness ideas, the payback hypothesis for both types of players appears to be valid. However, simple calculations show that even if the fairness ideas were exactly implemented, it would still generally be the case that the advantaged party at the end of round 1 would maintain his/her advantage, in expectation, through round 2.

Turn next to Table 5b, which reports the average second round proposals by each type of player and conditioning on each of the two possible pie realizations in the first round. As can be seen, both players do condition their initial proposal on the realized size of the pie in round 1 – FP players demand 1.48 less, while RC players offer 1.24 less, on average, when the pie realization was low

Table 5: Perceived Fair Amount For FP Player and Round 2 Bargaining Positions

(a) Fairness Perceptions

	Round 1 Pie:	
Player Type	Low	High
FP Player	8.32	10.95
RC Player	7.75	11.07

(b) Round 2 Initial Proposals

	Round 1 Pie:	
Player Type	Low	High
FP Player	9.48	10.96
RC Player	7.61	8.85

Note: Panel (a) reports the average of the elicited fairness perceptions separately for each player role and for each realization of the pie in the first bargaining round. Panel (b) reports the average initial proposal for each player role, broken up by the round 1 pie realization.

rather than high. For FP players, this is significant at $p = 0.031$ according to a Wilcoxon sign-rank test, while for the RC players, it is significant at $p = 0.063$.[9]

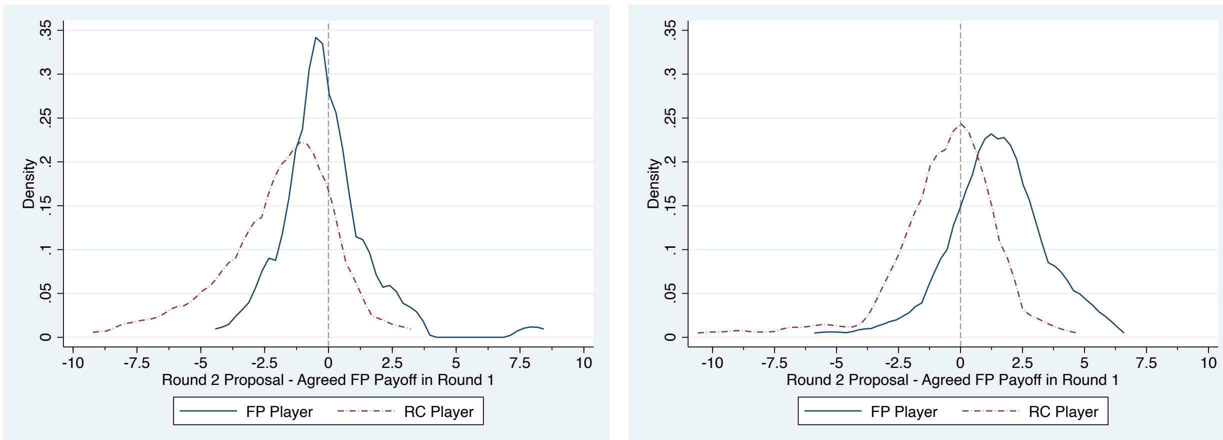
In support of Hypothesis 1, note that the differences in initial proposals conditional on the first round pie is smaller than the difference in perceived fair allocations conditional on the first round pie. Moreover, there is an interesting pattern. Specifically, when a player was in an ex post disadvantageous position, the average initial proposal is virtually identical to the perceived fair allocation. For FP players, compare the average initial claim of 10.96 when the first round pie was high with the perceived fair allocation of 10.95. Similarly, for RC players, compare the average initial offer of 7.61 when the first round pie was low with the perceived fair allocation of 7.75. In both cases, we are unable to reject equality of means at $p \gg 0.1$. On the other hand, when a player was in an ex post advantageous position, both players' initial proposals are far from the perceived fair allocation (for FP players 9.48 versus 8.32; for RC players, 8.85 versus 11.07) and the differences are significant at $p = 0.031$ according to Wilcoxon sign-rank tests. Indeed, in this case, the offers are much closer to the average agreed payment to the FP player in round 1 of 9.55. Thus it appears that players adopt self-serving, status-quo based bargaining positions when it is to their advantage. On the other hand, when the round 1 outcome was to their disadvantage both player types' round 2 bargaining positions are almost identical to their perceived fair allocation – that is, they demand payback.

To give a sense of the dispersion of second round claims, Figure 3 reports kernel density estimates of the difference between second round proposal and first round agreed payoff to the FP player, broken apart by player type and the realization of the pie in round 1. Unsurprisingly, the mode of the distribution for FP players is always to the right of the mode for RC players. Also consistent with what appear to be self-serving norms, when the round 1 pie was 14, the mode for FP players is only slightly to the left of 0; when the round 1 pie was 26, the mode for RC players is almost exactly at 0. That is, when the round 1 outcome was advantageous, it is common to adopt a "status quo" bargaining position. On the other hand, when the outcome was disadvantageous to the player, the mode of the distribution demands payback; that is, for RC players, the distribution is left-shifted when the pie was 14 and for FP players, the distribution is right-shifted when the pie was 26.

[9] Using $t-$tests, both differences are significant at $p < 0.015$.

Figure 3: Kernel Density Estimates of Difference Between Round 2 Proposals and Round 1 Agreement

(a) Round 1 Pie: 14 (b) Round 1 Pie: 26



Note: The dashed vertical line is at 0; which corresponds to the second round claim being identical to the first round payoff to the FP player.

Result 3 *Consistent with Hypothesis 1, players make initial proposals consistent with self-serving notions of fairness. That is, the advantaged party's initial proposal was closer the the status quo (i.e., round 1 agreement), while the disadvantaged party's initial proposal was closer to their fairness idea.*

5.3 Determinants of Initial Bargaining Positions

In Table 6 we report a regression analysis of round 2 proposals on fairness perceptions and the realization of the pie in round 1. Here, in contrast to our analysis based on matching group averages, the regression analysis shows that proposals, for both players, are significantly correlated with fairness perceptions when the realized pie in round 1 was low. When the pie in round 1 was high, again for both players, there is no relationship between fairness perceptions and proposals. Instead, when the pie was high in round 1, there is a shift upwards in proposals.

Two other interesting results are apparent from column (3) of Table 6(a). First, there is a positive relationship ($p < 0.1$) between the first round payoff and the second round claim. Thus, FP players may be behaving opportunistically. Having secured a more favorable agreement in round 1, they may sense a bargaining advantage going into round 2 and, therefore, claim more. Second, the claims of FP players are highly significantly negatively correlated with their risk preferences. That is, more risk averse FP players demand less. This is also interesting because risk preferences did not seem to play a role in the first round. It suggests that even risk averse FP players were trying to build a reputation (also by holding out until the last second). However, in the second round, when there is no future with the same opponent, their choices are influenced by their risk preferences.

Table 6: Round 2 Proposals, Round 1 Pie Realization and Fairness

(a) FP Players' Initial Claim

	(1)		(2)		(3)	
R1 Pie: 26	3.890**	(1.281)	4.075**	(1.387)	4.551**	(1.188)
Fairness Perception						
R1 Pie: 14	0.190	(0.107)	0.193	(0.108)	0.268**	(0.075)
R1 Pie: 26	−0.076	(0.145)	−0.090	(0.153)	−0.075	(0.134)
FP Round 1 Payoff			0.144	(0.088)	0.143	(0.078)
FP Risk Param.					−2.759**	(0.351)
Constant	7.926**	(0.940)	6.523**	(1.249)	6.751**	(0.942)
Observations	144		144		144	
R^2	0.22		0.26		0.41	

(b) RC Players' Initial Offer

	(1)		(2)		(3)	
R1 Pie: 26	4.272*	(2.065)	4.235*	(2.077)	2.301	(2.016)
Fairness Perception						
R1 Pie: 14	0.337*	(0.159)	0.333*	(0.165)	0.308	(0.168)
R1 Pie: 26	−0.028	(0.155)	−0.025	(0.160)	0.138	(0.099)
FP Round 1 Payoff			0.179	(0.231)	0.305	(0.217)
RC Risk Param.					−0.069	(0.657)
Constant	4.953**	(1.263)	3.258	(2.970)	2.424	(2.684)
Observations	144		144		134	
R^2	0.14		0.16		0.28	

Notes: In panel (a) the dependent variable is FP player's initial claim in Round 2, while in panel (b) the dependent variable is the RC player's initial offer in Round 2. We condition only on those cases for which an agreement was reached in round 1. For regressions including risk preferences, we include only those subjects for which $|\rho| < 1$. **1% and *5% significance using standard errors clustered at the matching group level.

Result 4 *More risk averse FP players make significantly weaker initial claims. For both players, fairness ideas are associated with initial proposals, especially when the round 1 pie was low.*[10]

5.4 Analysis of Agreements Reached

As noted above, an agreement was concluded 93.33% of the time before the expiration of bargaining. In such cases, the average agreed payment to the FP player was 8.86 following a low pie realization in round 1 and 10.34 following a high pie realization in round 1. These results are consistent with Hypothesis 2 (i.e., payback) at the aggregate level. In particular, $8.90 < 9.55$ ($p = 0.031$; Wilcoxon sign-rank test) and $9.55 < 10.34$ ($p = 0.031$; Wilcoxon sign-rank test); that is, the agreed FP payoff in round 1 is strictly in between the agreed FP payoffs in round 2 when the pie in round 1 was low

[10] To be sure, the fairness result should be taken with some caution as the significance of the coefficient differs whether or not risk preferences are included.

and high. Note, however, that the amount of payback is quantitatively rather small. For example, conditional on the pie in round 1 being low, on average, the FP player earns 18.45 overall, while the RC player can expect to earn 15.55 overall. Thus, the FP player still earns nearly ECU3 more than the RC player when the pie in round 1 was low. The situation is flipped, and even more extreme, when the pie in round 1 was high. In this case, the FP player earns approximately 19.87, while the RC player can expect to earn 26.13 – over ECU6 more. Thus, the party that earned more in round 1, because of the realization of the pie, earns more in expectation over the two rounds in which the players interact.

RESULT 5 *Consistent with Hypothesis 2, the amount that the FP player receives in round 2 is positively associated with the size of the pie in round 1. That is, there is payback. However, payback is insufficient to equalize expected earnings across both rounds.*

5.5 Round 2 Bargaining Process

Having looked at bargaining outcomes, we now wish to look into the bargaining process. To do this, we will use theory as a guide. Observe that the concession stage in round 2 is essentially a war of attrition. Let y_i denote the amount that player i demands for/offers to the FP player. We can characterize a stationary mixed strategy equilibrium by noting that each player must be indifferent between conceding at time t and waiting to concede at time $t+1$. Let p_i denote the concession probability for player i. Consider first the FP player. The indifference condition is:[11]

$$y_{RC} = p_{RC} y_{FP} + (1 - p_{RC}) \delta y_{RC}.$$

Solving for the concession probability of the RC player yields,

$$p_{RC} = \frac{(1-\delta) y_{RC}}{y_{FP} - \delta y_{RC}}.$$

A similar calculation gives us the concession probability of the FP player:

$$p_{FP} = \frac{(1-\delta)(20 - y_{FP})}{20 - y_{RC} - \delta(20 - y_{FP})}.$$

Given these concession probabilities, the expected concession time of each player (ignoring the behavior of the other player) is $\Delta_i := 1/p_i$, while the overall expected duration is then given by $\Delta := 1/(p_{RC}+p_{FP})$.

Observe that there should be a relationship between these variables and the likelihood that a player concedes. For example, the likelihood that player i is the one to concede should be decreasing in Δ_i and increasing in Δ_{-i}. Similarly, the duration of bargaining should be positively correlated with Δ_{FP}, Δ_{RC} and Δ, while the likelihood agreement should be negatively correlated with these variables.[12]

[11] Given the probability of termination used in the experiment, $\delta = 0.9945$.

[12] One could do a similar exercise based on the expected utility of the proposals. In this case, we would expect that the concession probability of player i is a function of player j's risk aversion. Under CRRA utility, it is possible to show that p_{RC} is increasing in the FP player's risk aversion, ρ_{FP}. Unfortunately, the relationship between the FP player's concession probability, p_{FP}, and the RC player's risk aversion, ρ_{RC}, need not be monotonic. We have conducted the analysis reported in Tables 7 and 8 using these measures and the results are qualitatively unchanged.

We first look at the determinants of which player concedes. At the aggregate level, it appears that the residual claimant is the one to accept approximately 57.6% of the time that incompatible claims are made, while the fixed payoff player accepts only 33.9% of the time that incompatible claims are made.[13] In the first two columns of Table 7 we report random effects regressions where the dependent variable takes value 1 if the RC player conceded and 0 otherwise. In contrast to the prediction, the residual claimant is *less* likely to concede the *higher* is the FP player's expected concession time (Δ_{FP}). Also in contrast to the prediction, the residual claimant is *more* likely to concede the *higher* is their own expected concession time (Δ_{RC}). From the second column, we see that risk preferences do not significantly influence the likelihood that the RC player concedes.[14]

Table 7: Likelihood Residual Claimant Concedes and Likelihood of Agreement

	RC Player Concedes				Agreement Reached			
$\Delta_{FP}/100$	-0.244^{*}	(0.099)	-0.245^{*}	(0.109)	-0.288^{**}	(0.109)		
$\Delta_{RC}/100$	0.114^{**}	(0.024)	0.113^{**}	(0.021)	0.034^{**}	(0.012)		
$\Delta/100$							-0.373^{*}	(0.155)
ρ_{FP}			0.124	(0.125)	-0.170^{**}	(0.046)	-0.157^{**}	(0.041)
ρ_{RC}			0.102	(0.179)	0.044	(0.128)	0.049	(0.132)
Constant	0.617^{**}	(0.086)	0.556^{**}	(0.105)	1.087^{**}	(0.087)	1.057^{**}	(0.078)
Observations	216		216		216		216	
R^2	0.031		0.039		0.123		0.102	

Note 1: Under the columns "RC Player Concedes", the dependent variable takes value 1 if the RC player conceded in the concession stage of Round 2 and 0 otherwise. Under the columns "Agreement Reached", the dependent variable takes value 1 if an agreement was reached in the concession stage of Round 2 and 0 otherwise. We include only those bargaining pairs which made incompatible claims in Round 2. Additionally, we include only those observations for which $|\rho_i| < 1$ for both players.

Note 2: **1% and *5% significance using standard errors clustered at the matching group level.

In the third and fourth columns we look at the determinants of an agreement being reached (that is, either player concedes). Consistent with the prediction, there is a negative relationship between Δ_{FP} and an agreement being reached. However, the relationship actually turns significantly positive for Δ_{RC}, but the magnitude is smaller. We also see that agreements are significantly less likely when dealing with a more risk averse FP player. This suggests that risk averse FP players "stick to their guns".

Turn now to Table 8 where we examine the relationship between bargaining duration and expected duration. In columns (1) and (2) we include Δ_{FP} and Δ_{RC} separately, while in columns (3) and (4) we include the expected duration, Δ, only. The results are very similar to those reported above on the likelihood of agreement. Consistent with the prediction, actual duration is increasing in Δ_{FP}. However, in contrast to the prediction it is decreasing in Δ_{RC}. We also see that duration is significantly increasing in the FP player's risk aversion, providing further evidence that they are more likely to "stick to their guns".

[13]That is, the rate of disagreement, conditional on incompatible claims is approximately 8.5%.

[14]However, if we condition on the fact that *one player* does concede, then ρ_{FP} is significantly positively associated with the RC player being the one to concede.

Table 8: Bargaining Duration

	(1)		(2)		(3)		(4)	
$\Delta_{FP}/100$	56.443**	(12.936)	57.160**	(12.336)				
$\Delta_{RC}/100$	−12.798**	(4.949)	−13.228**	(4.823)				
$\Delta/100$					47.825*	(22.662)	47.354*	(23.818)
ρ_{FP}			24.812*	(10.693)			21.888*	(9.005)
ρ_{RC}			10.907	(23.534)			9.680	(23.108)
Constant	18.819**	(5.646)	8.929	(6.982)	26.515**	(4.646)	17.965*	(7.772)
Observations	216		216		216		216	
R^2	0.127		0.144		0.049		0.062	

Note 1: The dependent variable is the time at which bargaining ended. If one player conceded, this is the time at which concession occurred. If neither player conceded, then this is the latest time at which a player could concede before bargaining stopped. Recall that we imposed a blocking design so this was the smallest multiple of 60 seconds *after* bargaining randomly terminated. We include only those bargaining pairs which made incompatible claims in Round 2. Additionally, we include only those observations for which $|\rho_i| < 1$ for both players.

Note 2: **1% and *5% significance using standard errors clustered at the matching group level.

Result 6 *Player concessions are inconsistent with the mixed strategy predictions, while agreements and bargaining duration are more consistent with the predictions – especially for Δ_{FP} and Δ. Additionally, it appears that more risk averse FP players hold out longer, which increases the likelihood of disagreement and increases bargaining duration.*

Remark 1 *The result that risk averse FP players make weaker claims is generally consistent with the literature. In particular, it is a robust finding that more risk averse subjects generally choose lower effort in contests and are less likely to enter into tournaments (Dechenaux et al., 2015). The result that risk averse FP players are unlikely to concede was not hypothesized ex ante and is unexpected on theoretical grounds. While most war of attrition studies show that subjects expenditures are too high (Kimbrough et al., 2020), we would not expect more risk averse subjects to hold out longer. It is, therefore, possible that it is due to a correlate of risk aversion, rather than risk aversion itself. One possibility is cognitive ability (Dohmen et al., 2010). For example, it may be that the risk averse FP players in our experiment suffer from the sunk-cost fallacy (Augenblick, 2016) or an escalation of commitment bias, both of which could cause the "stick to your guns" behavior that we observe. Unfortunately, our data do not allow us to test this conjecture.*

Lastly, we seek to understand the determinants of expected payoffs in Round 2. For the FP player, this is just the amount they receive in any agreement (or 0 in case of disagreement), while for RC players, it is their expected payoff, averaging over the realized pie size in the event of an agreement. We regress this on "process" variables such as the claim that the subject made and the time at which bargaining ended (either because one of the players accepted or because bargaining naturally terminated without agreement), as well as outcome variables from Round 1 (realized pie size, payoff to the FP player, was an agreement reached in round 1).

As can be seen, for both player types, expected payoffs are initially increasing in the amount

Table 9: Expected Round 2 Payoffs

	FP Player		RC Player	
Claim	1.926**	(0.639)	1.821**	(0.380)
Claim^2	−0.067*	(0.033)	−0.126**	(0.019)
Barg. End Time	−0.056**	(0.007)	−0.056**	(0.008)
(Barg. End Time)^2	0.002*	(0.0001)	0.0001	(0.0001)
Round 1 Pie: 26	0.928*	(0.399)	−0.595	(0.485)
FP Round 1 Payoff	0.007	(0.087)	−0.357*	(0.153)
Round 1 Agree	−1.206	(0.778)	2.486	(1.352)
Constant	−1.628	(3.119)	6.299*	(2.509)
Observations	140		140	
R^2	0.275		0.314	

Note 1: For each column, the dependent variable is the expected payoff of the player noted in the column heading. For the FP player this is either 0 (if disagreement) or the negotiated amount (if agreement). For the RC player, this is either 0 (if disagreement) or their expected payoff given the negotiated amount to the FP player (if agreement). We include only those observations for which $|\rho_i| < 1$ for both players.

Note 2: **1% and *5% significance using standard errors clustered at the matching group level.

claimed (by FP players) or offered (by RC players). For FP players, expected payoffs are increasing over the relevant range of initial demands in Round 2 (i.e., up to 14), while for RC players, a maximum is reached at around 7.23. This makes sense because while a more generous offer may increase the chance of agreement, it also leaves less for the RC player. We also see that expected payoffs are decreasing in the bargaining end time. This is further evidence that the players are not conceding according to the predicted concession probabilities. Furthermore, subjects are generally holding out too long. Conditional on an agreement, the predicted duration is approximately 28.3 seconds, while the actual duration is 35.6 seconds. Although the difference is only 7.3 seconds, it means that a disagreement is approximately 4 percentage points more likely to occur.

Table 9 also shows how round 1 outcomes influence round 2. Specifically, FP players receive payback when the pie in round 1 was high. On the other hand, RC players earnings are history dependent: the more their opponent earned in round 1, the less they earn in round 2, something which indicates that skill may be at play. Moreover, RC players earn more in round 2 if they successfully reached an agreement in round 1. This may be indicative of bargaining skill or that players are less demanding in round 2 if they have already secured some earnings in round 1.[15]

Result 7 *FP players' expected earnings in round 2 are increasing over the relevant range of initial claims. Both players' expected earnings are decreasing in the bargaining end time, which suggests an inconsistency with mixed strategy equilibrium play and a tendency to wait too long to concede.*

[15]Indeed, round 2 claims are closer together and claims are more likely to be compatible if an agreement was reached in round 1.

6 Conclusion

In this paper we studied the influence that asymmetric exposure to risk affects bargaining in a setting where players must negotiate with the same opponent over two bargaining rounds. Because of asymmetric exposure to risk, an agreement that was ex ante fair will necessarily lead to ex post inequality when the players must negotiate an agreement in a second round of bargaining. Thus, we can study how dynamic notions of fairness affect behavior in a natural setting, rather than the more abstract settings that have been studied to date (e.g., Trautmann and van de Kuilen, 2016; Andreoni et al., 2020).

Consistent with these papers, our results suggest that players have dynamic notions of fairness; that is, a limited form of payback is considered fair by both the fixed payoff players and residual claimants. The advantaged party from the first round is expected to sacrifice in the second round in order to equalize earnings over the duration of their interaction. However, when it comes to actual bargaining, players who were in an advantageous position after the first period outcome made offers which were consistent with the status quo, while players who were in a disadvantageous position made offers which were consistent with their fairness perceptions for payback. Because of these competing bargaining positions, while the average agreements are consistent with payback, the amount is qualitatively very small and there is still substantial inequality in expected total payoffs over the two bargaining rounds in favor of the advantaged party based on the round 1 pie realization.

Despite not being exposed to risk, the risk preferences of FP players appear to exert strong influence on behavior. While they are successfully able to hide their risk preferences in the first round, their risk preferences reveal themselves in surprising ways in the second round. As might be expected, the more risk averse FP players make weaker initial claims. However, if they reach the concession stage, they are unlikely to concede. This is a key driver of disagreement in round 2. These two findings explain why more risk averse FP players earn substantially less in our experiment. Indeed, our results suggest that FP players would earn more by making more demanding initial claims while, at the same time, being more willing to concede should the concession stage be reached.

Our analysis of the round 2 bargaining process showed that concession behavior is inconsistent with mixed strategy equilibrium: a residual claimant is less likely to concede against an FP player with a smaller probability of concession (i.e., longer expected duration); similarly the residual claimants who are themselves expected to hold out longer are more likely to concede. Despite this contrast with what one might expect, bargaining duration and agreements are much more consistent with the predictions. They are both positively related to the overall expected duration ($\Delta = {}^{1}\!/_{p_{FP}+p_{RC}}$) as well as with the FP player's expected duration. Yet, these are not the only factors at play. As noted, increased FP risk aversion is strongly associated with longer duration and a decreased likelihood of agreement.

In future work, it would be interesting to give players the ability, but not the obligation, to negotiate a long-term contract. Andreoni et al. (2020) suggests that some players may prefer to commit to a long-term contract in order to avoid the necessity for payback in a subsequent negotiation. However, it would be interesting to see if their result extends to our bargaining environment.

Acknowledgements

I gratefully acknowledge the University of Texas at Dallas and Maastricht University for financial support and Matthew Embrey for his early contributions to this work. I would also like to thank Eyal Ert (Associate Editor) and two anonymous referees for their helpful comments.

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A The Determinants of Disagreement in Round 1

Although disagreement was very infrequent, Table A.1 looks at the determinants of round 1 disagreements. As above, we add the same explanatory variables. When variables are included individually, as in columns (1)–(3), only the fairness perception of the FP players is significantly positively associated with disagreement. When all variables are included simultaneously in (4), we also see that opening offers for the FP player are positively associated with disagreement but does not reach significance at the 5% level ($p < 0.1$). We also see, somewhat surprisingly, that the opening offer of the RC player is positively associated with disagreement. This might be picking up something else. For example, RC players who make high opening offers might be unwilling to subsequently make concessions, which might increase the risk of disagreement. Although significant, the effect is quantitatively very small.

Table A.1: Determinants of Round 1 Disagreement

	(1)		(2)		(3)		(4)	
FP First Off.	0.018	(0.011)					0.022	(0.012)
RC First Off.	0.006	(0.004)					0.006*	(0.003)
FP Risk Param.			0.012	(0.022)			0.003	(0.025)
RC Risk Param			0.028	(0.080)			0.002	(0.080)
FP Fairness					0.023**	(0.006)	0.026**	(0.005)
RC Fairness					−0.019	(0.016)	−0.020	(0.019)
Constant	−0.211	(0.142)	0.031	(0.027)	−0.015	(0.132)	−0.333*	(0.158)
Observations	272		280		280		272	
R^2	0.02		0.00		0.04		0.06	

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

B Further Analysis of Round 2 Proposals

In this section we analyze further the regressions reported in 4. Specifically, for each set of variables, we report the results of a regression with that group as the only explanatory variables. The results in column (5) replicate those reported in the main text.

Table B.1: The Determinants of Compatible Round 2 Proposals

(a) Likelihood of Compatible Proposals

	(1)		(2)		(3)		(4)		(5)	
FP Risk Param	0.579^{**}	(0.065)							0.298^{**}	(0.066)
RC Risk Param	−0.080	(0.081)							0.048	(0.045)
FP Claim			-0.163^{**}	(0.017)					-0.138^{**}	(0.016)
RC Claim			0.131^{**}	(0.020)					0.137^{**}	(0.018)
Round 1 Agree					0.201^{**}	(0.035)			0.117	(0.114)
Round 1 Pie: 26							-0.126^{*}	(0.059)	-0.118^{**}	(0.044)
Constant	0.072	(0.058)	0.800^{**}	(0.197)	0.036^{**}	(0.009)	0.296^{**}	(0.052)	0.339	(0.231)
Observations	280		280		280		280		280	
R^2	0.108		0.518		0.013		0.020		0.553	

(b) Likelihood of Agreement Given Incompatible Proposals

	(1)		(2)		(3)		(4)		(5)	
FP Risk Param	-0.149^{**}	(0.049)							-0.199^{**}	(0.046)
RC Risk Param	0.008	(0.152)							0.043	(0.135)
FP Claim			−0.047	(0.025)					-0.059^{**}	(0.021)
RC Claim			0.047^{*}	(0.024)					0.039	(0.023)
Round 1 Agree					-0.088^{**}	(0.014)			-0.109^{**}	(0.027)
Round 1 Pie: 26							0.044	(0.064)	0.071	(0.097)
Constant	0.954^{**}	(0.064)	1.040^{**}	(0.143)	1.000^{**}	(0.000)	0.891^{**}	(0.042)	1.336^{**}	(0.143)
Observations	216		216		216		216		216	
R^2	0.017		0.069		0.005		0.006		0.107	

Note 1: In panel (a), the dependent variable is an indicator variable which takes value 1 if the players' proposals were compatible. That is, $y_{FP} \leq y_{RC}$, and 0 otherwise. In panel (b), the dependent variable is an indicator variable which takes value 1 is the players reach an agreement in the concession stage. This regression, therefore, includes only those bargaining pairs for which their initial proposals were *incompatible*. We include only those observations for which the estimated risk parameters $|\rho_i| < 1$ for both players.

Note 2: **1% and *5% significance using standard errors clustered at the matching group level.