Bargaining Power with Endogenous Surplus

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Abstract

This paper reports the results of a bargaining model that provides agents with a choice between production and protection in a setting with a winner-take-all disagreement point, and then examines this model by conducting a laboratory experiment. Using different endowments and different contest success functions, we find that most agents over-invest in preparing for disagreement. Additionally, we find that many agents compromise rather than engage in conflict, even when it is more profitable to do so.

1 Introduction

In any finite bargaining situation, the consequences of a breakdown in negotiations must be considered, especially in situations where, instead of a split of resources, one party receives all of the negotiated amount. Agents in these negotiations will take the possible breakdown into account when allocating resources, and the negotiations themselves are likely affected by these measures that agents have taken. For example, if one side in the negotiation has more (or more expensive) lawyers, we would expect them to achieve a better bargaining settlement than the other side, even if the lawyers are not involved in the bargaining directly.

If we consider negotiations under the threat of violence, or civil cases brought to trial, or negotiations in international relations, we understand that these breakdowns result in a winner-take-all result: one party acquires all of the bargained amount, and the other party is left with nothing. This idea is in contrast to many bargaining models, which use a disagreement point that could be worse for both parties. In this case, the disagreement point may be beneficial to one or the other party, but that benefit is random and is only achieved through the investment of resources into securing that benefit.

This suggests an economic decision for bargaining agents: allocating resources to production, in order to engage in profitable trade, or instead allocating resources to weaponry and security, in order to profitably acquire resources if negotiations fail. This choice leads to a situation where agents can agree to avoid a fight, but have the ability to fight if necessary, a situation called bargaining in the shadow of conflict.

Some examples are informative: in the first example, Ashenfelter et al. (2013) show that, in labor-management arbitration in New Jersey, eventually both sides hire lawyers, even though the lawyers are not required for the procedure and do not convey higher payoffs for either party. This process of each side increasing their allocations to lawyers leads to an inefficient equilibrium.

In the second example, companies pejoratively called "patent trolls," that produce no goods but threaten legal action based on patents that they hold (Wyatt, 2013), are extreme examples of allocating resources to acquisition. When patent trolls bring these lawsuits, it's unclear from a modeling perspective what the disagreement point is in the event that pre-trial settlement talks fail.

In fact, the disagreement point in the event of a breakdown in settlement talks can be seen as random, based on the outcome of a trial susceptible to human error and other influences. In this example, settlement talks in a legal case are conducted with the knowledge that a winner-take-all result will occur if the negotiations fail.

Similarly, in international relations, countries bargain over disputed territory with the knowledge that, in the end, one country will end up controlling the territory in dispute. In this situation, rather than increase the productive output of the country through peacetime industry, countries may build up their military in order to influence the bargaining outcome and avoid conflict, known in the international relations literature as deterrence theory.

These examples all demonstrate bargaining situations where, unless there is a negotiated settlement, the winner takes all of the resources in dispute through a conflict resolution mechanism, whether it is arbitration, or a civil trial, or a military conflict. There are many more examples, such as bargaining outside of the rule of law, or intellectual property disputes between employees and employers, that are modeled in the same framework: negotiating in the face of a winner-take-all result.

This paper examines these situations. The two central innovations of this work are that, first, in the event that bargaining ends in conflict, the disagreement payoffs are random - that is, one side or the other gets the entire negotiated amount via a random drawing. Second, since agents choose to devote resources to productive effort or unproductive acquisition, more resources spent on weaponry or security implies fewer resources available for trade. While other articles have examined similar situations, none have done so by coupling this with a bargaining environment.

We test these ideas in a laboratory environment, where we can control for the many exogenous factors that complicate field data in this area, such as previous interactions or incomplete information. The experiment is, at its center, a two-person bargaining game where agents can allocate resources to trade or conflict, and where the disagreement points are winner-take-all, determined at random. The two-person game has three decision-making phases: allocation, where agents decide between protection and trade; demand, where agents make claims on their joint contributions to trade; and concession, where, if demands are incompatible, agents can concede to the other agent's offer.

After conducting this experiment, we find that subjects invest more in the unproductive acquisition (which we call, in this paper, allocating to defense) than is predicted by the mutual best response of risk neutral agents. Additionally, we find that subjects avoid conflict much more often than the predicted rate of risk neutral agents. We examine two possible explanations for this. The first is the well-known risk preference for risk aversion. The second is generosity[1], as found in most dictator games. We find evidence for both present in the data.

[1]We use the term "generosity" to represent the other-regarding preferences of a more well-off agent, as described in Bolton & Ockenfels (2000) and Fehr & Schmidt (1999). Our model is not able to distinguish between these other-regarding preference formulations, but we see this as an area for future study.

This paper is based on previous theoretical work, discussed in Section 2. Section 3 examines previous laboratory experiments on bargaining in the shadow of conflict. Section 4 describes the bargaining game at the heart of the experiment, and Section 5 looks at how the experiment was conducted. Section 6 states the predictions we made for this experiment, and Section 7 details the results of the experiment, while Section 8 discusses some of the implications of our findings. Section 9 concludes.

2 Theoretical Motivation

This paper incorporates three different areas of theoretical literature: work on the economic approach to conflict, work on contest success functions, and work on bargaining in the shadow of conflict.

Jack Hirshleifer originated the economic approach to considering conflict. Hirshleifer (2001) addressed behavior of agents that was infrequently addressed by economics: the process of acquisition and confiscation through conflict. These agents could be countries, corporations, or individuals. He outlined, in broad terms, that agents can achieve gains through both productive output and conflict.

Hirshleifer also formulated the Paradox of Power, his hypothesis explaining the apparent success of relatively weak parties in a conflict, such as Vietnam during the US-Vietnam conflict. He asserted that the success of these weaker parties was inversely related to what he termed the decisiveness of the power used in the conflict. Decisiveness, in international terms, means the lethality of the weaponry used by the stronger power. To wit, an increase in decisiveness increases the likelihood of the stronger party winning the conflict. He explored this idea in an experiment with co-authors, discussed in the next section.

His proposed decisiveness is modeled as a part of a contest success function, something studied in the contest area of game theoretic literature. Contests are lotteries among n agents where each agent i chooses a costly effort level e_i. A contest success function is a function that transforms the effort expended by each party into a probability that each party would win the random draw. The simplest contest of this type to understand is a raffle. Agents spend effort (in the form of money) to purchase raffle tickets, and a winner is drawn from all the tickets purchased. If each of the tickets is the same price (e.g. \$1 each), then the contest success function for any agent is their effort divided by the total effort expended. If, however, each ticket was not the same price (e.g. a person who spends \$10 gets 11 tickets), then a different contest success function is employed.

This paper focuses on the 2-agent case, so agents' efforts are delineated as e_1 and e_2. After efforts are chosen, the probability of agent 1 winning is represented by this contest success function:

$$p_1(e_1, e_2) = \frac{f(e_1)}{f(e_1) + f(e_2)}$$

Where f is a nondecreasing function that, in the original formulation by Skaperdas (1996), is identical for both agents.[2] Hirshleifer's decisiveness concept equates to the rate of increase of f.

Two of the most used contest success functions are the ratio and difference functions. The ratio contest success function sets $f(e_i) = e_i$ and thus has the form:

$$p(e_1, e_2) = \begin{cases} \frac{e_1}{e_1+e_2} & \text{if } e_1 + e_2 \neq 0 \\ 0.5 & \text{if } e_1 + e_2 = 0 \end{cases}$$

This function is easy to explain to subjects and has an intuitive appeal. However, the discontinuity as the efforts approach zero means that marginal calculations are difficult.

The other function is the difference contest success function[3], often called the Tullock

[2] This was later extended to the case of different functions for each player in Clark & Riis (1998).

[3] These contest success functions were generalized and applied to conflict situations by Hwang (2009), who looked at historical conflicts to calibrate an appropriate contest success function for war.

contest success function from its description in Tullock (1980). The difference contest success function specifies f as the exponential function and thus has the form:

$$p(e_1, e_2) = \frac{\exp(e_1)}{\exp(e_1) + \exp(e_2)}$$

Our work relies on Hirshleifer's decisiveness concept, and on these two contest success functions, for our hypotheses and experiment. It also relies on the idea of agents exploring alternatives to a conflict with a necessarily random winner-take-all outcome. This negotiation in the economic literature is known as bargaining in the shadow of conflict. Powell (1996) formulates this in the form of side-payments for a Rubinstein alternating-offer game. Skaperdas (2006) outlines the format for this bargaining, and notes that bargaining outcomes would be less likely given a lack of divisibility of the resource being bargained, and would be less likely in an environment of incomplete information.[4]

One important implication of this bargaining in the shadow of conflict environment is that, since there is a contest at the end, the disagreement point of the bargaining process is endogenous and random. Esteban & Sákovics (2007) develop an n-person bargaining model with endogenous disagreement points, showing that the specification of a disagreement function is the key part in solving the theoretical bargaining problem. We use this structure, using the contest success function for the disagreement function.

Thus, our work takes the original conflict framework of Hirshleifer with the contest literature idea of contest success functions, along with Esteban and Sakovics' treatment of endogenous disagreement points, to create our bargaining model. We additionally look to other experiments for other insights into conflict and bargaining in the shadow of conflict.

[4]Skaperdas also notes that conflict has a finality, while bargained solutions are still under the threat of conflict (assuming that any arms-reducing agreements are unenforceable).

3 Previous Experimental Findings

Previous experiments can be divided into two main branches: contest experiments and conflict experiments. Contests have been studied often in the experimental literature. Sheremeta (2013) reviews thirty prior experiments and shows that they consistently find overinvestment in contests; that is, effort levels so high that they are more inefficient than the predicted levels for risk neutral agents.[5] Sheremeta notes that there are some experiments where the levels of investment are so high that they lead to negative payoffs for the contest winners. In our experiment, since bargaining is surrounded by a contest, we expect to see the same level of overinvestment.

For conflict experiments, Abbink (2012) provides an overview of early conflict experiments. Durham et al. (1998) (Yvonne Durham, Jack Hirshleifer, and Vernon Smith) is the earliest example of a conflict experiment, where subjects choose between a productive public goods-type investment and an acquisitive conflict investment with two different destructiveness parameters. They find support for Hirshleifer's Paradox of Power: increased decisiveness leads to increased conflict. However, their experiment models bargaining as an investment in a public goods-style game, as opposed to an explicit bargaining situation.

Lacomba et al. (2016) experiments with changing the contest success function between a difference contest success function and an all-pay auction.[6] They find that the all-pay

[5] To give an example, recall our raffle. Imagine you and another player are the only contestants for a prize worth \$10. If you each purchase one \$1 ticket, your expected value is \$4 ((0.5 x 10) - 1). If your opponent instead buys five, while you do not purchase any additional tickets, her expected value is \$3.33 ((0.833 x 10) - 5). That is an example of overinvestment

[6] All-pay auctions can be characterized as a contest in which the contest success function is

$$p(e_1, e_2) = \begin{cases} 1 & \text{if } e_1 > e_2 \\ 0.5 & \text{if } e_1 = e_2 \\ 0 & \text{if } e_1 < e_2 \end{cases}$$

Using an all-pay auction with our bargaining game would lead to a prediction of more investment in the control endowment (due to symmetry), while the predictions of the treatment endowment remain the same, since the marginal benefit of investment resembles that of the difference contest success function that we use.

auction increases the inequality of the subjects, while the difference contest success function reduces the inequality. Their findings are broadly in line with ours, although their design does not include a bargaining component.

Sánchez-Pagés (2009) uses a different approach to study a similar situation: one where the threat of conflict can influence bargaining outcomes among agents of differing strengths. In his model, two agents with incomplete information bargain, but either can terminate the bargaining at any time and engage in either low- or high-intensity conflict.

Smith et al. (2014) find that increasing arming costs increases bargaining outcomes. They use a bargaining game very similar to our design (although we derived ours independently), and use a repeated game format for their interactions.

Additionally, Kimbrough & Sheremeta (2013) find that binding side payments (as we model) and even non-binding payments can reduce the occurrence of conflict. The latter is a surprising result, and speaks to an increased desire to avoid conflict even when agreements are unenforceable. Although this is presented as a contest paper, the applications to the bargaining in the shadow of conflict environment are clear.

Thus, several experiments have examined similar situations to the one described in our introduction. However, the game proposed here has several innovations.

First, the size of the pie is endogenous, leaving the amount subject to trade to the discretion of the agents. This means that the model includes the important allocation decisions that occur prior to bargaining: allocating resources to the amount to be traded or allocating resources to improve the chances of winning the entire pie. This reflects Hirshleifer's original idea of effort being directed towards arms or productive output, and provides a choice for agents made under uncertainty.

Second, the disagreement point is random. In the standard model, agents receive a payoff of zero or a set disagreement payoff. In this model, the size of the disagreement payoff is the entire bargained pie, awarded randomly to one of the agents based on their contest success function (described later). Remembering that the size of the pie is based on the allocations made in the first phase of the game, we can think of this departure from the standard game as modeling the destructiveness of the conflict, as in Smith et al. (2014).

Third, the experiment includes a lottery task that attempts to ascertain subjects' risk preferences by providing a choice between safe and risky lotteries over a range of winning probabilities. We use this lottery task to estimate each agent's risk preference, and correlate the results of this task with the bargaining decisions the agent makes. This lottery task is further described in Section 8. This task is helpful in examining deviations from risk neutral predictions, since risk aversion is a commonly cited explanation for these deviations.

4 Model

We construct a model to examine the decisions agents make when negotiating with others. We include a decision between relative safety and increased trade (the allocation decision), and two decisions between a sure payoff and a random winner-take-all drawing (the demand and concession decisions).

This game is an extensive form game, split into five phases. In the middle three, players make decisions simultaneously. Since this game has simultaneous moves, it is not a game of perfect information. Agents know the endowments and previous choices of their opponent (as well as their own), but agents do not know the risk preferences of the other player. Without knowing these risk preferences, subjects cannot determine the payoffs for the other player.

Thus, while the game is one of incomplete information, there is reason to believe that agents in this game are risk neutral for the low stakes that obtain in this experiment. Rabin (2000), following from Arrow (1966), argues that for small stakes (as in this experiment) agents are approximately risk neutral, otherwise they would be improbably risk averse for larger stakes.[7] If true in this case as well, it allows for two important assumptions: first, that players would know the payoff functions of their opponents (they would be approximately equal to the risk neutral payoff, that is, the expected value of the game). The consequence of this first assumption is that this game can be analyzed as one of complete information. Second, it strengthens our belief that the risk neutral mutual best response is a good approximation for the economic behavior of the agents. Nevertheless, we include the lottery task to elicit each subject's risk preference to make sure this is the case.

This experiment uses the framework of the compressed Zeuthen game, as described in Sopher (1994). In the compressed Zeuthen game, players make claims on an exogenous pie, and if these claims add up to more than the size of the pie, players are allowed the option to accept the other player's claim (receiving the remainder of the pie).

The game is divided into five phases: endowment, allocation, demand, concession, and disagreement resolution. We discuss each separately.

4.1 Endowment

Subjects begin each period of the game with an endowment of units. They divide this endowment between an allocation to a protection fund (which we call defense) and an allocation to a joint fund (the pie to be divided by the pair of subjects). One treatment in this experiment is an alteration of the endowments. In the control sessions, each subject is endowed with five units. In the treatment sessions, one subject (randomly chosen at the start of each period) is endowed with seven units, and their opponent is endowed with three units. This allows us to examine whether entering bargaining in the shadow of conflict with a larger endowment leads to a higher payoff. Subjects know at the start of each period both their endowment and their opponent's endowment.

[7] Guillaume Frechette points out that this could mean, instead, that agents have different utility functions for low and high stakes, in which case this argument does not hold.

4.2 Allocation

Once the subjects learn their endowment and their opponent's endowment, they decide how many units to allocate to be used in the event of a disagreement (called, in this paper, "allocation to defense"). These allocations influence their chance of success in the event of a disagreement via the contest success function.[8] Note that, for each bargaining pair, the sum of the contest success functions is one.

All decisions in this game must be made in whole number amounts. Since we add an odd number of units for gains from trade, forcing discrete decision amounts allows us to ensure that, if agents face a 50-50 equilibrium, their allocations to defense are not equal. This allows us to study agents behavior without the complicating factor of allocational fairness as described in Bolton et al. (2005).

Units that aren't allocated to defense contribute to the size of the pie to be bargained over. This is one tension of this experiment: whether subjects will increase the chances of acquiring the whole pie in the event of a disagreement, or increase the potential amount to be shared through productive effort. The socially efficient equilibrium would be for subjects to allocate zero to protection, thus giving the largest possible payoff to the bargaining pair as a whole. However, this cooperative level would be difficult to maintain in this game, since defecting to a non-zero allocation would greatly raise the probability of the defecting player to acquire the entire pie.[9]

Once each paired subject makes his or her allocations, the size of the pie is determined.

[8] Note that these allocations can also be seen as purchasing probabilistic insurance, as described in Wakker et al. (1997). A greater allocation to defense leads to a higher probability of winning the conflict, if the opponent's allocation remains constant. Since agents, on average, are more willing than risk neutral agents to allocate units to defense, the findings in this paper contradict the findings expressed in that article that agents are relatively reluctant to purchase probabilistic insurance.

[9] This probability increases to one in the ratio contest success function.

The size of the pie is:

$$PieSize = (endowment_i - allocation_i) + (endowment_j - allocation_j) + GainsFromTrade$$

The gains from trade are additional amounts representing the benefits of trading with their partner, otherwise autarky, and the lack of protection required in an autarkic situation, would be Pareto improving for both.[10] In this experiment, the gain from trade is one unit.

4.3 Demand

Subjects demand a whole number of units of the pie. If the demands are compatible (that is, the sum of the demands is less than or equal to the pie size), both subjects receive their demands as their payoff and the game ends. Note that compatible demands may be inefficient, as they may add up to less than the size of the pie (in which case the extra units are discarded). If demands are not compatible, the game moves to the concession stage.

4.4 Concession

If the demands are not compatible, subjects are given the choice to concede to the demand of the other player or to reiterate their original demand. If agents concede to the demand of the other player, they receive the remainder of the pie after the other player's demand has been satisfied.

It is possible that both agents may concede and accept the demand of the other player. This is another potential source of inefficiency (again, extra units are discarded).

If neither subject concedes, then a disagreement is reached and the pie is awarded to one or the other as described below.

[10] In the results, we find that subjects would have done much better in autarky than in trade - the risk neutral Nash equilibrium predicts this - but autarky was not allowed in this experiment. Adding additional gains from trade, as well as an option for autarky, would be a fruitful extension to this experiment.

4.5 Disagreement Resolution

If subjects cannot come to an agreement, a random number is drawn and the entire pie is awarded to either the subject or her opponent based on the probabilities generated by their contest success functions. This is the second tension of this experiment: whether agents accept a sure payoff from the bargaining process or a risky payoff from the random draw in the event of a disagreement.

5 Experiment Design

5.1 Treatments

This experiment incorporates two treatments, in a standard 2x2 design.

In the first treatment, the experiment studies the effect of equal versus unequal endowments. In the control endowment group, each subject is endowed with 5 units. In the treatment endowment group, one subject, endowed with 7 units, is matched with another subject endowed with 3 units. These endowments change each period, so subjects have experience in both roles and we can mitigate between-subject differences.

In the second treatment, the experiment uses two different contest success functions, the ratio function and the difference function, described above. The difference function has a higher marginal benefit to investment in defense, and we believe that this would lead to even more overinvestment.

These treatments, along with the number of subjects in each treatment, are described in Table 5.

5.2 Logistics

These hypotheses were tested through a laboratory experiment. Subjects were undergraduate volunteers who signed up on a web site from a pool of mostly economics and business students.

Eight experimental sessions were run, two for each cell in Table 5. A total of 48 subjects participated in the control groups, while 59 participated in the treatment groups.[11] These participants are broken down into the 2x2 design in Table 5. No communication was allowed between subjects during the experiment.

Each subject played twelve periods of the bargaining game, which took approximately twenty minutes to complete. Since instructions and recruiting materials indicated that the experiment would last up to 90 minutes, subjects were not told that there was a fixed number of bargaining periods, and were not aware that the experiment would end after twelve periods, thus there's no reason to believe that differing behavior in the later periods is due to a limited time horizon.

Subjects then participated in a lottery task, choosing between ten relatively safe or relatively risky lotteries, discussed further in Section 8. This task took approximately four minutes.

Subjects were paid based on three measures. First, all subjects were paid a \$5 show-up fee. Second, for each subject one bargaining period was picked at random and the subject was paid double their earnings for that period (earnings ranged from zero to sixteen dollars in this phase). Third, subjects were also paid double the result of one of their risk assessment lotteries, chosen at random (earnings ranged from \$0.20 to \$7.70 in this phase). Earnings for subjects in the experiment ranged from \$5.20 to \$26.70, with a median payment of \$14.20.

These payments were constrained by two competing needs: first, the payments must have

[11] One subject participated in two treatment sessions. His second set of observations are excluded from the analysis and not included in the count of treatment subjects, although the observations for subjects he was paired with remain in the analysis.

been large enough so that the undergraduate subjects would be incentivized to maximize their payoff. Second, the payments must have been small enough relative to the wealth of the undergraduates that the Rabin/Arrow conclusion regarding risk neutrality remained viable.

The bargaining game for this experiment was conducted entirely on computer, and was programmed in z-tree, a programming language designed specifically for economic experiments (Fischbacher, 2007).

The experiment sessions took place in the Wachtler Laboratory on the campus of Rutgers in New Brunswick, New Jersey, between April 25 and April 28, and between November 16 and 17, 2016. The experiment was approved by the Rutgers Institutional Review Board for the School of Arts and Sciences. Changes to the instructions needed to be made for the contest success function treatment, as expecting subjects to figure out the probabilities implied by the difference contest success function prior to choosing their allocation was too onerous. Both sets of instructions for the experiment are in the appendix.

6 Predictions

6.1 Risk Neutral Mutual Best Response

One way to examine behavior in this game is to show the baseline behavior for two risk neutral agents. This risk neutral mutual best response will provide predictions for the behavior of subjects in the experiment.[12]

In the risk neutral mutual best response for the ratio contest success function, the best response for agents with both treatment and control endowments is to first allocate three units to defense, resulting in bargaining over a pie of size five. Each agent would then

[12]Some theorists object to the term "Risk neutral Nash equilibrium," as an equilibrium must be such for all risk attitudes, but if such a concept were conceivable, the definition would be identical to a risk neutral mutual best response. Because the final stage of this game has a random draw, this game is not a discrete extensive form game, and therefore may not have a subgame perfect Nash equilibrium.

demand three from the pie. Since these demands are more than the size of the pie, each would be presented with a chance to concede for a sure payoff of two. Since this is less than the expected value of 2.5, risk neutral agents would refuse to concede, and one would be awarded the pie of size five.

For the difference contest success function, the best response for agents with endowments of five or seven units is to allocate four to defense. However, agents endowed with three can not meet this allocation, and they would allocate all three of their units to defense. The rest of the description above remains identical, except for the expected value for calculation. The expected value for agents endowed with five is 1.5, for an endowment of three is 1.08, and for an endowment of seven is 2.92.

This can be expanded to a strategy profile: risk neutral agents would allocate to defense in accordance with Table 4. Once these choices are made, their expected value is revealed. They would then make a demand for the next integer above their expected value. If that demand and their opponent's demand were larger than the pie, the agent would not concede (since any opponent offer that would make the sum greater than the size of the pie would lead to a concession amount that would be smaller than the agent's expected value).

6.2 Hypotheses

For this experiment, we believe that we will see overinvestment in the first phase. That is, the allocation to defense will be larger than the risk neutral prediction (for those subjects who can invest more than the prediction). We believe this for two reasons. First, we believe that agents would believe that other agents would also overinvest, and would not want to start the bargaining game in a potentially weaker position than their opponent (this follows from an arms race game theorized by Baliga & Sjöström (2004). Additionally, there is an empirical regularity noted in the review of contest experiments in Sheremeta (2013), where "Out of 30 studies, 28 studies document statistically significant overbidding." If this hypothesis were true, it would extend the findings of these contest experiments to contests with previous bargaining phases.

Hypothesis 1: *While all subjects will allocate more to defense than the risk neutral mutual best response prediction (where possible), better-endowed subjects will allocate much more.*

Additionally, we expect that changing the contest success function in a way that increases the marginal benefit of allocation to defense would magnify this effect. We believe that the subjects will be sensitive to this increase and will make their choices accordingly. In other words, subjects are responding to the likelihood of winning when they allocate to defense, and not to some other exogenous factor.

Hypothesis 2: *Designating a contest success function with a higher marginal benefit from investment to defense will increase these overinvestments.*

We also think that the agents endowed with more units would benefit more from the bargaining environment. This would follow conventional wisdom, that the better-endowed agents would do better in the bargaining environment, even though the risk neutral mutual best response prediction does not indicate such a benefit.

7 Results

We find that overinvestment does happen, in accordance with our first hypothesis. However, changing the contest success function did not lead to increased overinvestment relative to the risk neutral prediction. Additionally, we find that bargaining agreements happen much more often than are hypothesized.

The risk neutral mutual best response prediction, along with summary results from the control and treatment sessions, are summarized in two tables. Table 6 looks at the ratio contest success function, while Table 7 looks at the difference contest success function. We address each phase of the game in detail.

7.1 Allocation

For the control endowment in the ratio contest success function, we see that there was a larger allocation to defense (3.33 units) than the risk neutral mutual best response of three, although not larger by a statistically significant amount. This allocation is, however, statistically different from zero, which would be the socially efficient equilibrium of no investment in defense and the largest possible pie to divide.

For the treatment endowments, we see that the lower-endowed subjects invest less in defense (2.12 units) than the prediction, while the higher-endowed agents invest more than the predicted amount: 4.38 units. The average among the two groups (3.26) is higher than the predicted amount and close to the control treatment.

This lower predicted amount among the lower-endowed subjects is surprising. While it may be unreasonable to think that every subject would allocate all of their resources to defense (as would be necessary to meet the prediction of three), 49.6% of all subjects endowed with three units allocated fewer than three units to defense. This behavior, so far from the prediction, warrants further study.

In the difference contest success function, we see two interesting findings. First, we expect to see an even larger investment by the higher endowed subjects. However, while the absolute number is higher (4.60 units), that number is closer to the risk neutral mutual best response prediction of 4 units.

Second, we expect a higher allocation to defense from the control endowment group, but the absolute amount is very similar to the ratio contest success function: 3.28 units. Thus, for the control group, there is essentially no change between the control and treatment contest success functions.

Thus, we do see slightly higher investment than the risk neutral prediction, but not as much as we hypothesized, and not as much (in relative terms) when the contest success function changes.

7.2 Demand

We predict that the subjects will demand the risk neutral demand level: that is, that they will demand the next highest integer above their expected value. In most cases, the subjects, on average, demand slightly more than the risk neutral level: subjects endowed with three or five units demand, on average, 0.362 units and 0.614 units more, respectively, in the ratio contest success function treatment, and 0.115 and 0.847 units more in the difference contest success function treatment.

The subjects endowed with seven units, however, demand very close to the risk neutral prediction, demanding slightly more in the ratio contest success function and slightly less in the difference contest success function. It's unclear why these numbers would be so much closer to the predicted amounts.

Subjects' demands are small enough to be compatible 20.4% of the time across all treatments. The risk neutral mutual best response prediction states that this should happen zero percent of the time. This result is discussed further in Section 8.

7.3 Concession

Subjects concede to their opponents 10.4% of the time. If we remove the observations where both subjects make compatible offers, and thus are not given the option to concede, this number rises to 13.1%. This is higher than the predicted amount of zero. We discuss the ramifications of this in Section 8.

7.4 Payoff

Payoffs are lower than the predicted payoffs, except for the higher endowed subjects. Although there is some inefficiency - due to subjects demanding amounts that sum to less than the pie, or due to both subjects conceding - lower payoffs are mainly a result of lower allocation rates among the lower-endowed subjects.

7.5 Compromise

While the risk neutral prediction for compromises (or successful bargaining outcomes) is zero, we see in Table 8 that there are many more compromises than that. 40.0% of all periods (259 observations) end without conflict, far from the risk neutral mutual best response prediction of zero. This is the largest missed prediction of the risk neutral mutual best response framework, and warrants additional discussion.

Of these 259, 68 (26.3%) ended when one of the subjects was offered the opportunity to concede for more than their expected value payoff. Since these subjects were earning a payoff higher than their expected value, we can make no inferences about their motives *vis-a-vis* their unwillingness to engage in conflict. 59 (22.8%) ended when a subject accepted their opponent's offer, which was for less than their expected value. 132 (51.0%) ended when the paired subjects made demands which summed to less than or equal to the total size of the pot.

While we might think that the lower-endowed subjects would be more willing to make lower demands, defined as lower than the risk neutral prediction. These demands are more likely to avoid conflict. However, we see in Table 9 that the higher-endowed subjects make lower demands 25.4% of the time in the control ratio success function and 27.8% of the time in the difference contest success function, as opposed to 18.4% and 11.1%, respectively, for the lower-endowed subjects.

We will focus on possible reasons for this, along with possible reasons for concessions, in our discussion in Section 8.

8 Discussion

8.1 Explaining Compromises

This section will review the desire of subjects to compromise in the shadow of conflict, a result that has an analogue in Durham et al. (1998), where the authors found a lower level of fighting effort than their prediction.

While there may be other reasons (such as misunderstanding the game) why these subjects might have made these choices, we discuss two explanations in particular: generosity and risk aversion.

If the subjects made the choices they did due to generosity, they chose a payoff less than their expected value to get a certain payoff for both themselves and their opponent. Generosity has been found in the large majority of dictator game experiments. Engel (2011) conducted a meta-study and found a level of generosity of 28.4% across 616 treatments. It's possible similar behavior is reflected in the decisions made by these subjects.

If, however, subjects made the choices they did due to risk aversion, they were choosing a lower payoff for sure rather than a risky larger payoff. As we mentioned, from examining the demand and concession decisions, it's impossible to tell which (if either) may have been the true motivation for the choice observed. We present two attempts to examine these issues. Interestingly, neither shows a clear answer, pointing to an area for future research.

After each subject played the bargaining game for twelve periods, they took part in a lottery task, constructed using the same decisions as in Holt & Laury (2002). This lottery task is a series of ten lotteries with the same prizes but changing probabilities, as illustrated in Figure 1. The number of relatively safe choices a subject makes is an indicator of their risk aversion.

Ideally, we would observe each subject switch from the low-risk lottery to the high-risk lottery once, indicating the level of their risk preference. However, in the lottery decisions observed, 18 of the 107 subjects switched back from a high-risk lottery to a low-risk choice. This percentage (16.8%) is near the reported level in Holt & Laury (2002) for their subjects' first real-money lottery, where they found 13.2% of the subjects switched back. Holt & Laury (2002) include these observations in their results by counting the number of low-risk choices as the correct level of risk aversion.

As seen graphically in the scatter plot in Figure 3, there is no correlation between the decisions in the bargaining game and the number of safe choices chosen in the lottery task. This may be due to the simultaneous nature of the lottery task versus the serial nature of the bargaining game. It's also possible that there are sequential effects, as found in Bednar et al. (2012). That is, the nature of the bargaining game made subjects approach the lottery task differently than they would have had they taken the lottery task in a separate session.

Another way to examine whether this behavior in the demand and concession phases is due to risk aversion or generosity is to look at the first phase of the bargaining game, the allocation phase. By looking at the allocations these subjects make on the periods when they compromise, we may gain insight into their reasoning. Intuitively, a subject that is risk averse in the demand and concession phases would be more likely to choose an allocation to defense larger than the risk neutral mutual best response, in order to protect against a larger allocation from their opponent (this aligns with the discussion of probabilistic insurance in Note 8). Similarly, a subject that is generous in the demand and concession phases would be more likely to choose an allocation to defense smaller than the risk neutral mutual best response, so that the bargained pie will be larger for both subjects. While this is not a perfect analogue to the demand and concession behavior, it may be a useful proxy for the behavior.

The results of this analysis can be found in Figure 2, which examines the allocation to defense for subjects who later in the same period compromise. The results are surprisingly similar: 34.1% of subjects who compromise in the later phases allocate less than the predicted amount, indicating possible generosity, while 34.4% allocate more, indicating possible risk aversion. If this allocation behavior is an accurate proxy of demand and concession behavior, it suggests that some subjects compromise due to generosity and some due to risk aversion.

While no subject compromised in every period, twenty-two subjects (12.5%) chose to not enter conflict six or more out of the twelve periods of the experiment, as noted in Figure 3. This suggests that many subjects were more willing to compromise than others. We can explore this further by looking at all of the concession choices the subjects made. The subjects in the concession phase were presented with the option accepting a discount on their expected value for a sure payout. If we take the largest discount factor for the concessions they make, coupled with the smallest discount for the concessions they did not make, then we can establish the range of discounting they would take to get a sure payoff (or to ensure that both parties received a sure payoff).

This only works if the largest concession discount is smaller than the smallest non-concession discount. This is not true for 31 of the subjects, which leaves 76 subjects, 62 of which never conceded. For the remaining fourteen, some have small ranges in which their discount factor would reside, as illustrated in Table 12. In twelve of the fourteen subjects, their estimated discount factor is lower than 35%, while in four of the fourteen it's at least 20%. This suggests a significant, though not implausible, level of risk aversion for these stakes (although, again, a completely implausible level for higher stakes).

In summary, after analyzing the data using two different methods, it's unclear whether the number of compromises by subjects can be explained by either generosity or by risk aversion or by a mix of both.

8.2 Why do higher endowed subjects get larger payoffs?

The average higher-endowed subject earns a slightly higher payoff than the risk neutral mutual best response prediction, because the lower-endowed subject allocates less to defense than the predicted amount. However, the average higher-endowed subject does worse than the expected value conditional on the original allocations. This could suggest the appearance of the aforementioned risk aversion. Whatever the reason may be, the clear finding is that the increased endowment only affects payoff through the allocation channel.

The regression results in Table 10 illustrate this point. The subjects endowed with 7 units do not gain any intrinsic benefit from having the higher endowment. Instead, their benefit comes from their ability to make a higher allocation to defense. Thus, subjects with higher endowment, faced with a decision to enlarge the pie or better ensure their gain of the entire pie should bargaining fail, choose the latter and receive a higher payoff than predicted.

9 Conclusion

This paper describes an experiment on bargaining in the shadow of conflict with a winner-take-all contest if bargaining fails. It finds that subjects, on average, allocated more to defense than the risk neutral prediction, although this difference does not increase when changing the contest success function to provide a higher marginal benefit to allocation to defense. Additionally, the paper finds that subjects came to a bargaining agreement more often than predicted.

Reasons for the increased allocation to defense have been provided in the previous contest literature, and could involve a preference for winning or other-regarding preferences. Reasons for increased agreements have been discussed in this paper, and may include risk aversion or generosity.

One goal of this experimental framework is to build a game where the initial endowments will or will not matter, based on the parameters specified in each laboratory session. In our pursuit of this, we will make additional changes to the contest success function, lowering the marginal benefit to allocation to defense, to see if this will provide more payoff equality, as hypothesized by Hirshleifer's Paradox of Power.

These bargaining situations play an important role in our lives. Assessing the importance of a higher endowment on entering these situations can have a profound effect on our ideas about what a fair bargaining environment must include. Policies, for example, that cap the amount that can be spent on defense, whatever the form it takes, may lead to less spent on unproductive attempts at acquisition.

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Appendix

Instructions for April sessions

Instructions for Bargaining Experiment

Thank you for agreeing to participate in this experiment. This is an experiment in the economics of decision making. In the experiment you will make decisions and earn money, as described in the instructions below. At the end of the experiment you will be paid your earnings in cash.

The experiment will consist of several rounds of decision making. In each round you will be randomly paired with another participant. The decisions you and the other participant make will determine your potential earnings in that round. At the end of the experiment, one round will be randomly chosen to determine your earnings in the experiment. You will also be paid $5 simply for having shown up on time for the experiment today.

The currency in this experiment is **Francs** All monetary amounts in the experiment are denominated in Francs. At the end of the experiment your earnings in Francs will be converted to US Dollars for the rate of $2 per 1 Franc.

In each round you will start out with an account consisting of a set number of francs. The person you are paired with will also start out with a set number of francs. The number of francs that you start out with may be different from the number of francs that the person you are paired with starts out with. You will know the exact number of francs that you and the person you are paired with start out with before you begin making decisions.

At the start of each round, you will be randomly matched with another person. You will not know this person's identity, and the other person will not know yours. In each round, there are several decisions that you will make. First, you will decide on how many francs to allocate to two different funds. There is a Joint Fund, to which you and the person you are paired with may contribute, and there is a Private Fund. Francs allocated to the Joint Fund will influence the total number of francs that you and the person you are paired with may negotiate over to determine your earnings for the round. Specifically, the total of the francs that you allocate and that the person you are paired with allocate to the Joint Fund, plus an additional franc, will determine the total that you and the other person will negotiate over.

The francs allocated to your Private Fund will influence the chances that you will earn money in the round in the event that you and the person you are paired with are not able to reach an agreement on how to divide the Joint Fund. Similarly, the francs that the other person allocates to his or her Private Fund will influence the chances that the other person earns money in this round. Note that the francs that you allocate to your Private Fund will not be part of your earnings at the end of the round - your earnings come solely from the Joint Fund.

After you decide how many francs to simultaneously allocate to the Joint and Private funds, you and the person you are paired with will see the size of the Joint Fund. Each of you will state a claim for a number of francs from the Joint Fund you would like to have. If the sum of what you and the other person claim is less than or equal to the size of the Joint Fund, then you both receive your claims.

If the sum of claims is larger than the number of francs in the Joint Fund, you then will have the choice of either accepting the other player's claim, or of reiterating your initial claim. If you agree to the other player's claim, then you receive the difference between the total Joint Fund and his or her claim (this number will be displayed for you to help with your decision). If you reiterate your initial claim, and the other player accepts your claim, then you receive your original claim. If you reiterate your claim and the other player reiterates his or her claim, then the entire Joint Fund will be distributed to one of you. Which of you receives the Joint Fund will be determined by a formula that depends on each person's Private Fund.

Specifically, the probability of you winning the entire Joint Fund is the number of francs you placed in the Private Fund, divided by the sum of the number of francs you and the other person placed in each of your Private Funds. This will be a number between zero and one. This number is the probability that you will be awarded the Joint Fund.

After the round is over, you will start another round, and be paired with another person. Each round will be conducted in the same way as described above. After several rounds of the bargaining game, you will be presented with a series of lotteries in two columns, as below: There will be real numbers in the place of a, b, c, and d. You will choose, for each row, which lottery you would rather participate in. After you choose for each row, one row will be chosen and the lottery that you chose for that row will be drawn.

After the lottery is drawn, you will be asked to complete a short questionnaire. This questionnaire has several questions about your demographic characteristics. No personally identifiable information is collected.

A few final notes: there is no communication allowed between people performing the experiment at any time. Please do not talk with other people in the experiment area. Also. please do not use your cell phone while in the experiment area.

Thank you again for your participation.

Instructions for November sessions

Instructions for Bargaining Experiment

Thank you for agreeing to participate in this experiment. This is an experiment in the economics of decision making. In the experiment you will make decisions and earn money, as described in the instructions below. At the end of the experiment you will be paid your earnings in cash.

The experiment will consist of several rounds of decision making. In each round you will be randomly paired with another participant. The decisions you and the other participant make will determine your potential earnings in that round. At the end of the experiment, one round will be randomly chosen to determine your earnings in the experiment. You will also be paid $5 simply for having shown up on time for the experiment today.

Table 1: Example series of lotteries

Column A	Column B
10% chance of winning a 90% chance of winning b	10% chance of winning c 90% chance of winning d
20% chance of winning a 80% chance of winning b	20% chance of winning c 80% chance of winning d
30% chance of winning a 70% chance of winning b	30% chance of winning c 70% chance of winning d
40% chance of winning a 60% chance of winning b	40% chance of winning c 60% chance of winning d
50% chance of winning a 50% chance of winning b	50% chance of winning c 50% chance of winning d
60% chance of winning a 40% chance of winning b	60% chance of winning c 40% chance of winning d
70% chance of winning a 30% chance of winning b	70% chance of winning c 30% chance of winning d
80% chance of winning a 20% chance of winning b	80% chance of winning c 20% chance of winning d
90% chance of winning a 10% chance of winning b	90% chance of winning c 10% chance of winning d
100% chance of winning a 0% chance of winning b	100% chance of winning c 0% chance of winning d

The currency in this experiment is **Francs** All monetary amounts in the experiment are denominated in Francs. At the end of the experiment your earnings in Francs will be converted to US Dollars for the rate of $2 per 1 Franc.

In each round you will start out with an account consisting of a set number of francs. The person you are paired with will also start out with a set number of francs. The number of francs that you start out with may be different from the number of francs that the person you are paired with starts out with. You will know the exact number of francs that you and the person you are paired with start out with before you begin making decisions.

At the start of each round, you will be randomly matched with another person. You will not know this person's identity, and the other person will not know yours. In each round, there are several decisions that you will make. First, you will decide on how many francs to allocate to two different funds. There is a Joint Fund, to which you and the person you are paired with may contribute, and there is a Private Fund. Francs allocated to the Joint Fund will influence the total number of francs that you and the person you are paired with may negotiate over to determine your earnings for the round. Specifically, the total of the francs that you allocate and that the person you are paired with allocate to the Joint Fund, plus an additional franc, will determine the total that you and the other person will negotiate over.

The francs allocated to your Private Fund will influence the chances that you will earn money in the round in the event that you and the person you are paired with are not able to reach an agreement on how to divide the Joint Fund. Similarly, the francs that the other person allocates to his or her Private Fund will influence the chances that the other person earns money in this round. Note that the francs that you allocate to your Private Fund will not be part of your earnings at the end of the round - your earnings come solely from the Joint Fund.

After you decide how many francs to simultaneously allocate to the Joint and Private funds, you and the person you are paired with will see the size of the Joint Fund. Each of you will state a claim for a number of francs from the Joint Fund you would like to have. If the sum of what you and the other person claim is less than or equal to the size of the Joint Fund, then you both receive your claims.

If the sum of claims is larger than the number of francs in the Joint Fund, you then will have the choice of either accepting the other player's claim, or of reiterating your initial claim. If you agree to the other player's claim, then you receive the difference between the total Joint Fund and his or her claim (this number will be displayed for you to help with your decision). If you reiterate your initial claim, and the other player accepts your claim, then you receive your original claim. If you reiterate your claim and the other player reiterates his or her claim, then the entire Joint Fund will be distributed to one of you. Which of you receives the Joint Fund will be determined by a formula that depends on each person's Private Fund.

Specifically, the probability of you winning the entire Joint Fund is the mathematical constant e (approximately 2.72) raised to the power of your Private Fund, divided by the sum of e raised to the power of your Private Fund and e raised to the power of the Private

Fund of the person you are matched with. This will be a number between zero and one. This number is the probability that you will be awarded the Joint Fund.

You will not need to calculate this. The last page of these instructions has a table where you can look up what the probability (expressed as a percentage) would be if you allocated a certain amount to your Private Fund and the person you are matched with allocated a certain amount to their Private Fund. Once the Joint Fund size is determined, this probability, expressed as a percentage, will be displayed for you.

After the round is over, you will start another round, and be paired with another person. Each round will be conducted in the same way as described above. After several rounds of the bargaining game, you will be presented with a series of lotteries in two columns, as below: There will be real numbers in the place of a, b, c, and d. You will choose, for each

Table 2: Example series of lotteries

Column A	Column B
10% chance of winning a 90% chance of winning b	10% chance of winning c 90% chance of winning d
20% chance of winning a 80% chance of winning b	20% chance of winning c 80% chance of winning d
30% chance of winning a 70% chance of winning b	30% chance of winning c 70% chance of winning d
40% chance of winning a 60% chance of winning b	40% chance of winning c 60% chance of winning d
50% chance of winning a 50% chance of winning b	50% chance of winning c 50% chance of winning d
60% chance of winning a 40% chance of winning b	60% chance of winning c 40% chance of winning d
70% chance of winning a 30% chance of winning b	70% chance of winning c 30% chance of winning d
80% chance of winning a 20% chance of winning b	80% chance of winning c 20% chance of winning d
90% chance of winning a 10% chance of winning b	90% chance of winning c 10% chance of winning d
100% chance of winning a 0% chance of winning b	100% chance of winning c 0% chance of winning d

row, which lottery you would rather participate in. After you choose for each row, one row will be chosen and the lottery that you chose for that row will be drawn.

After the lottery is drawn, you will be asked to complete a short questionnaire. This questionnaire has several questions about your demographic characteristics. No personally identifiable information is collected.

A few final notes: there is no communication allowed between people performing the experiment at any time. Please do not talk with other people in the experiment area. Also.

please do not use your cell phone while in the experiment area.

Thank you again for your participation.

Table 3: Determining winning probabilities

	If you allocate this to your Private Fund										
	0	1	2	3	4	5	6	7	8	9	10
And the player you are matched with allocates	Then your chance of being awarded the entire Joint Fund is										
0	50.000%	73.106%	88.080%	95.257%	98.201%	99.331%	99.753%	99.909%	99.966%	99.988%	99.995%
1	26.894%	50.000%	73.106%	88.080%	95.257%	98.201%	99.331%	99.753%	99.909%	99.966%	99.988%
2	11.920%	26.894%	50.000%	73.106%	88.080%	95.257%	98.201%	99.331%	99.753%	99.909%	99.966%
3	4.743%	11.920%	26.894%	50.000%	73.106%	88.080%	95.257%	98.201%	99.331%	99.753%	99.909%
4	1.799%	4.743%	11.920%	26.894%	50.000%	73.106%	88.080%	95.257%	98.201%	99.331%	99.753%
5	0.669%	1.799%	4.743%	11.920%	26.894%	50.000%	73.106%	88.080%	95.257%	98.201%	99.331%
6	0.247%	0.669%	1.799%	4.743%	11.920%	26.894%	50.000%	73.106%	88.080%	95.257%	98.201%
7	0.091%	0.247%	0.669%	1.799%	4.743%	11.920%	26.894%	50.000%	73.106%	88.080%	95.257%
8	0.034%	0.091%	0.247%	0.669%	1.799%	4.743%	11.920%	26.894%	50.000%	73.106%	88.080%
9	0.012%	0.034%	0.091%	0.247%	0.669%	1.799%	4.743%	11.920%	26.894%	50.000%	73.106%
10	0.005%	0.012%	0.034%	0.091%	0.247%	0.669%	1.799%	4.743%	11.920%	26.894%	50.000%

Figures and Tables

Option A	Option B
1/10 of \$2.00, 9/10 of \$1.60	1/10 of \$3.85, 9/10 of \$0.10
2/10 of \$2.00, 8/10 of \$1.60	2/10 of \$3.85, 8/10 of \$0.10
3/10 of \$2.00, 7/10 of \$1.60	3/10 of \$3.85, 7/10 of \$0.10
4/10 of \$2.00, 6/10 of \$1.60	4/10 of \$3.85, 6/10 of \$0.10
5/10 of \$2.00, 5/10 of \$1.60	5/10 of \$3.85, 5/10 of \$0.10
6/10 of \$2.00, 4/10 of \$1.60	6/10 of \$3.85, 4/10 of \$0.10
7/10 of \$2.00, 3/10 of \$1.60	7/10 of \$3.85, 3/10 of \$0.10
8/10 of \$2.00, 2/10 of \$1.60	8/10 of \$3.85, 2/10 of \$0.10
9/10 of \$2.00, 1/10 of \$1.60	9/10 of \$3.85, 1/10 of \$0.10
10/10 of \$2.00, 0/10 of \$1.60	10/10 of \$3.85, 0/10 of \$0.10

Figure 1: Choice of two lotteries to determine level of risk aversion

Source: Holt & Laury (2002)

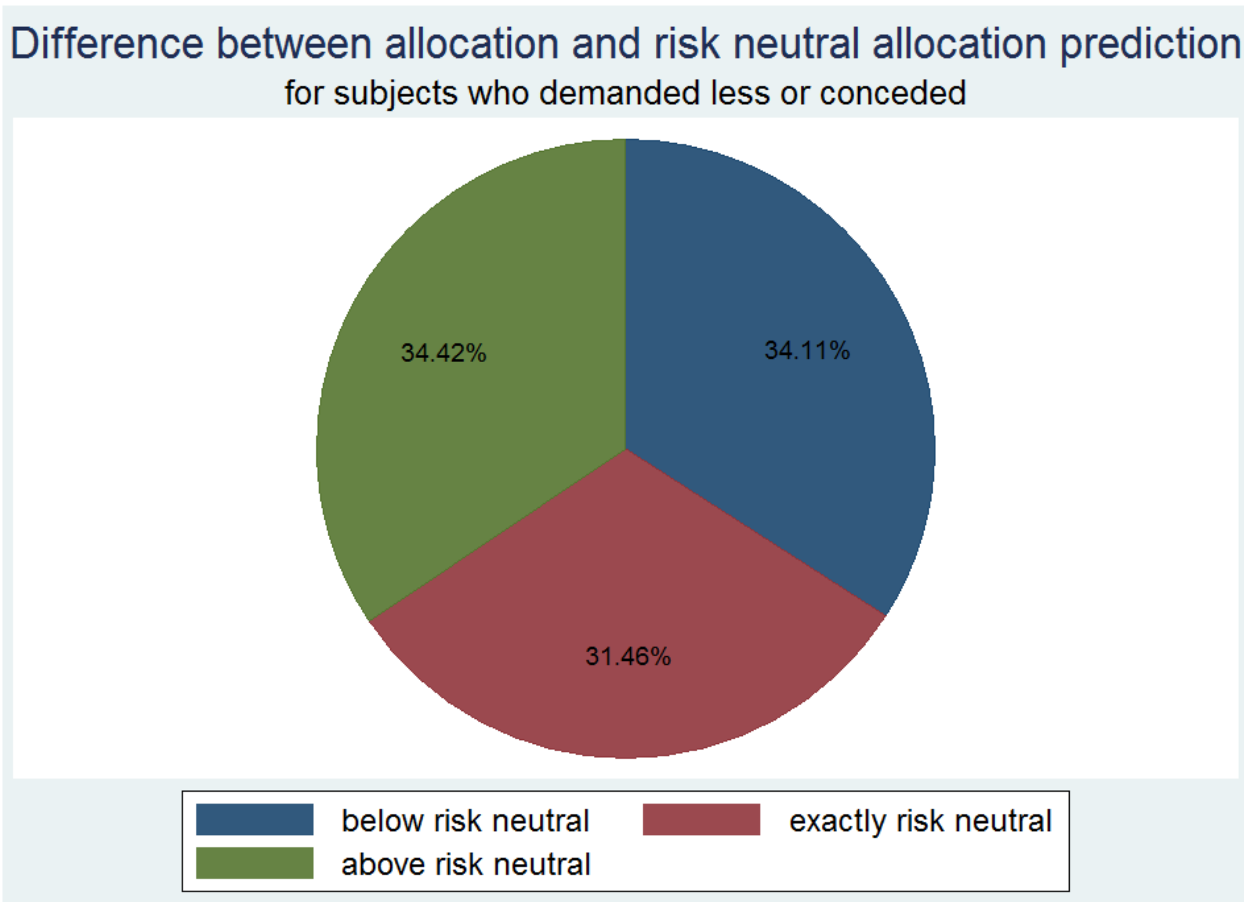

Figure 2: Do subjects who compromise allocate more or less than the risk neutral prediction?

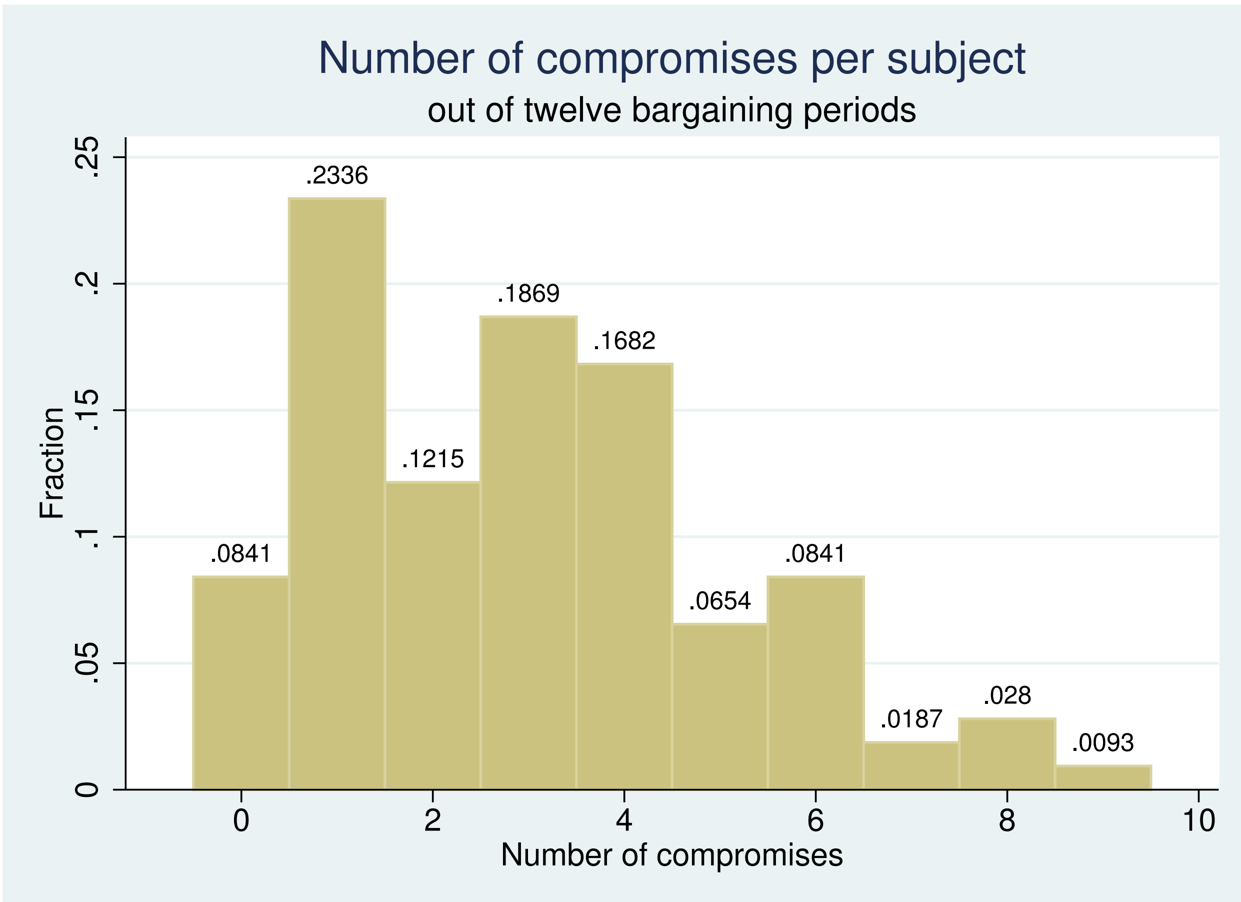

Figure 3: Number of compromises per subject (out of twelve periods)

Table 4: Best responses to allocation amounts

Allocation	Ratio best response	Difference best response
0	1	2
1	2	3
2	3	4
3	**3**	4
4	3	**4**
5	2	4
6	2	3
7	2	3

Table 5: Study participants over eight sessions (two for each cell)

	Control CSF (Ratio)	Treatment CSF (Difference)
Control endowment	32	16
Treatment endowment	35	24

Note: One participant in the treatment endowment and control CSF participated in the experiment twice. His observations are removed from the analysis.

Table 6: Summary of risk neutral mutual best responses and results for the ratio contest success function

	Best response prediction	Control 5 units	Treatment 3 units	7 units	All Treatment
Allocation	3	3.33	2.12	4.38	3.26
		(1.42)	(1.04)	(1.74)	(1.83)
Demand	ceiling(EV)	0.362	0.614	0.0892	0.348
(Δ risk neutral demand)		(1.55)	(1.38)	(1.27)	(1.38)
Concession	0	0.0614	0.0775	0.0316	0.0533
		(0.24)	(0.27)	(0.18)	(0.23)
Disagreement	100%	64.1%			58.8%
		(0.48)			(0.49)
Payoff	2.5	2.12	1.69	2.69	2.19
		(2.15)	(2.10)	(2.21)	(2.21)

Table 7: Summary of risk neutral mutual best responses and results for the difference contest success function

	Best response prediction	Control 5 units	Treatment 3 units	7 units	All Treatment
Allocation	4, 3, 4	3.28	2.22	4.60	3.41
		(1.53)	(0.955)	(1.73)	(1.84)
Demand	ceiling(EV)	0.115	0.847	-0.833	0.382
(Δ risk neutral demand)		(1.62)	(1.55)	(1.31)	(1.51)
Concession	0	0.0625	0.0903	0.0208	0.0556
		(0.243)	(0.288)	(0.143)	(0.229)
Disagreement	100%	64.1%			58.8%
		(0.501)			(0.483)
Payoff	1.5, 1.08, 2.92	2.16	1.26	2.85	2.05
		(2.08)	(1.98)	(2.03)	(2.15)

Table 8: Compromise percentages

	Ratio CSF	Difference CSF	Total
Control endowment	35.9%	51.0%	40.9%
Treatment endowment	41.2%	36.8%	39.4%
Total	38.7%	42.5%	40.1%

Table 9: Percentage of demands that are lower than the risk neutral predicted demand

	Control CSF (Ratio)	Treatment CSF (Difference)
Lower endowment (3)	17.2%	26.0%
Control endowment (5)	18.4%	11.1%
Higher endowment (7)	25.4%	27.8%

Table 10: Payoff Regression

	Dependent Variable: Payoff			
	Ratio CSF		Difference CSF	
Endowment of 3	0.342	(0.0794)	0.378	(0.118)
Endowment of 5	0	(.)	0	(.)
Endowment of 7	-0.0823	(0.0217)	-0.172	(0.137)
Allocation controls	Yes		Yes	
Pot size controls	Yes		Yes	
Demand controls	Yes		Yes	
Concession controls	Yes		Yes	
N	804		480	

$s$tandard errors (clustered by session) in parentheses

Table 11: Number of safe choices in lottery task for all subjects and consistent subjects

All Subjects

No. of safe choices	Desc. from Holt and Laury	Freq.	Percent	Cumulative
2	very risk loving	1	0.93	0.93
3	risk loving	12	11.21	12.15
4	risk neutral	22	20.56	32.71
5	slightly risk averse	25	23.36	56.07
6	risk averse	31	28.97	85.05
7	very risk averse	9	8.41	93.46
8	highly risk averse	4	3.74	97.20
9	stay in bed	2	1.87	99.07
10	stay in bed	1	0.93	100
Total		107	100	

Consistent Subjects

No. of safe choices	Desc. from Holt and Laury	Freq.	Percent	Cumulative
2	very risk loving	1	1.12	1.12
3	risk loving	11	12.36	13.48
4	risk neutral	17	19.10	32.58
5	slightly risk averse	18	20.22	52.81
6	risk averse	27	30.34	83.15
7	very risk averse	8	8.99	92.13
8	highly risk averse	4	4.49	96.63
9	stay in bed	2	2.25	98.88
10	stay in bed	1	1.12	100
Total		89	100	

Table 12: For the fourteen subjects that have a consistent discount range

Subject conceded if the discount factor was under	Subject did not concede if the discount factor was above
0.070	0.300
0.070	0.316
0.070	0.344
0.088	0.316
0.100	0.167
0.100	0.167
0.100	0.650
0.111	0.250
0.125	0.200
0.167	0.200
0.200	0.319
0.243	0.316
0.316	0.316
0.316	0.475