Stochastic bargaining over gains and losses: Evidence from the lab

Shuwen Li*　　Daniel Houser†

February 1, 2018

Abstract

We design experiments to investigate predictions of the Merlo and Wilson (1995) stochastic bargaining theory. We construct four Merlo-Wilson games where the timing and efficiency of the equilibrium predictions differ, and study them in both gain and loss domains. We find little equilibrium play, but rather that it is most common to agree to equal splits in efficient stages, i.e. stages with maximum aggregate surplus. When there is an equilibrium in an efficient stage, however, proposers are significantly less likely to offer an equal split, and instead make a proposal that is unequal in the direction of the equilibrium outcome. In addition, we find that males and females are equally likely to propose an equal split over gains, while male proposers are significantly more selfish over losses. This gender effect cannot be explained by differences in risk attitudes. Our results may shed light on some well-known gender differences in bargaining behavior.

Keywords: Sequential bargaining, Stochastic games, Gender differences, Laboratory experiments

JEL Codes: C78, C73, J16, C92

*Department of Economics and the Interdisciplinary Center for Economic Science, George Mason University, Fairfax, VA, United States. Email: sli13@masonlive.gmu.edu

†Department of Economics and the Interdisciplinary Center for Economic Science, George Mason University, Fairfax, VA, United States. Email: dhouser@gmu.edu

We gratefully acknowledge research support from the Interdisciplinary Center for Economic Science at George Mason University.

1 Introduction

Bargaining in natural environments typically includes delays prior to agreement. Such delays are commonly seen, for example, in formation of coalition governments in parliamentary democracy (Golder, 2010; Laver & Benoit, 2015), sovereign debt renegotiations (Dhillon, García-Fronti, Ghosal, & Miller, 2006; Pitchford & Wright, 2012), setting of industry standards in product markets (Simcoe, 2012) and corporate bankruptcy renegotiations (Eraslan, 2008). To model such delays, Merlo and Wilson (1995) develop a complete information multilateral stochastic bargaining framework where the surplus to be allocated and the order in which players move follow a general Markov process. Assuming a unanimity agreement rule, and depending on the nature of the stochastic processes for the surplus and the move-order, they show equilibrium may be delayed or immediate, and in either case may be efficient or inefficient.

Despite the empirical use and influence of the Merlo-Wilson (hereafter MW) model (Merlo, 1997; Diermeier, Eraslan, & Merlo, 2003; Benjamin & Wright, 2009; Merlo & Tang, 2012; Simcoe, 2012), there has not yet appeared any direct test of the model's microfoundations.[1] In this paper, we provide the first controlled laboratory test of the MW model. As a by-product of testing the model's equilibrium predictions, we discover how people reconcile efficiency and equilibrium in bargaining over gains and losses, as well as the nature of any gender differences in stochastic bargaining behavior.

Bargaining behavior over gains can differ from that over losses if people value losses differently than gains (in particular, due to "loss-aversion", Kahneman and Tversky (1979)). While some research has appeared on bargaining over losses (see, e.g., Camerer, Johnson, Rymon, and Sen (1993) and Lusk and Hudson (2010)) the area is arguably in need of more

[1]Another popular model used to study multilateral sequential bargaining is the Baron and Ferejohn (1989) (hereafter BF) where the proposer is recognized stochastically as in MW, but the surplus to be split is deterministic and shrinks over time due to discounting. Moreover, BF only requires majority approval for agreement. Recent experimental works on BF include comparison of open and closed ammendment rules (Frechette, Kagel, & Lehrer, 2003), effects of veto power in committees (Kagel, Sung, & Winter, 2010), roles of communication (Agranov & Tergiman, 2014), and impacts of legislative process on public good provision (Tergiman, 2015), etc.

study. One reason is that many negotiations in natural environments occur in the loss domain. Examples include those mentioned above, as well as household labor negotiations over housework and childcare, and peace negotiations.

Another reason to study behavior in loss domain is to develop a better understanding of gender differences in bargaining over losses. Such differences might improve our understanding of, for example, intra-household decision making as well as differences in gender leadership styles. While gender differences in preferences across both gain and loss domains is a flourishing field (see, e.g., Schubert, Brown, Gysler, and Brachinger (1999), Eckel and Grossman (2002), Fehr-Duda, De Gennaro, and Schubert (2006), Eckel and Grossman (2008), Croson and Gneezy (2009)), we believe we are the first to study gender differences in bargaining behavior over losses.

To formally test the MW model we construct four two-person two-stage games where unique Stationary Subgame Perfect Equilibria (SSPE) differ in terms of timing of agreement (immediate or delayed) and Pareto efficiency. Since a preference for equal splits is routinely found in economic environments (Andreoni & Bernheim, 2009; Güth & Kocher, 2014), we ensure an equal split alternative appears in each stage of our four games. The design of our games allows us to shed light on how players trade-off efficiency and equality with equilibrium, and how the presence of an equilibrium outcome in an efficient stage influences players' propensities to choose equal outcomes.

Each experimental session consists of two tasks: a real-effort task and then the MW bargaining task. Performance in the real-effort task determines each player's bargaining power, i.e. whether the player gets a favorable position in the bargaining task. Subjects earn their way to receiving payoffs in the bargaining rounds (Gain treatment), or earn their endowments and suffer losses in the bargaining rounds (Loss treatment). The real effort task thus is important both as a framing device to create a sense of losses, as well as in creating a sense that one has earned the right to be proposer and thus perhaps mitigating impulses for equal splits (Hoffman & Spitzer, 1985; Hoffman, McCabe, Shachat, & Smith, 1994; Oxoby

& Spraggon, 2008).

In each round of the Gain (Loss) treatment, two players, 1 and 2, in a pair decide the amount of gain (loss) that each of them receives (suffers). The person who performed better in the real-effort task is assigned the role of Player 1. In stage 1, Player 1 can make a proposal or pass. If the proposal is accepted by Player 2, the round ends and the two players earn (lose) the agreed-upon amounts. Otherwise, the players proceed to stage 2. In stage 2, either Player 1 or Player 2, each with 50% chance, can make a new proposal. If the proposal is accepted, the two players earn (lose) the agreed-upon amounts. If it is rejected, both of them earn zero (lose their earnings from the real-effort task). Subjects are then randomly rematched to begin a new round. In all, they play four rounds of each of the four games.

We find that the plurality of agreements occur in efficient stages, regardless of the presence of equilibrium. That is, it is most common for players to agree in the stage that includes the largest surplus. Importantly, although a considerable number of agreements are equal splits, when the SSPE exists in an efficient stage the proposer is more likely to make an unequal offer in the direction of the equilibrium (thus, unequal in favor of the proposer).

Regarding gender effects, we find that male and female proposers are equally likely to choose equal splits in the gain domain. In particular, regardless of gender, about half propose an equal split over gains. However, male proposers become significantly more selfish in the loss domain. Whether the bargaining is over gains or losses does not modulate female bargaining behavior. Further, risk attitudes cannot explain this gender gap.

Our paper makes both methodological and substantive contributions. Methodologically, we use a novel stochastic bargaining design that includes a real-effort task and enables inferences about bargaining behaviors in both the gains and loss domains, as well as the role of equilibrium in influencing bargaining outcomes. Substantively, we find that males bargain more aggressively than females in the loss domain, which may help to explain some well-known differences in bargaining behavior (Babcock & Laschever, 2009; Sandberg, 2013).

2 Literature Review

2.1 Applications of the MW Model

The MW model has been widely used as a tool for empirical analyses, using the equilibrium predictions of the model as identifying restrictions in empirical research. For example, Merlo (1997) provides a structural estimation of the model using data on the duration of negotiations and government durations in postwar Italy. Diermeier et al. (2003) estimate a verision of the MW model using data from nine West European countries over 50 years. Dhillon et al. (2006) apply the model to explain both the final settlement and the delay in achieving it in the Argentine debt swap in the early 2000s. Finally, Simcoe (2012) estimates a MW model to explain empirical regularities regarding standard setting committees.

2.2 Framing Effect in Negotiations

Inspired by Kahneman and Tversky (1979), researchers have studied the gain-loss framing in laboratory negotiations, with most of them finding that losses are more painful than the equivalent gains are pleasant, and that loss-framed negotiators bargain more aggressively and make fewer concessions (Bazerman, Magliozzi, & Neale, 1985; Dreu, Emans, Vliert, Carnevale, et al., 1994; Camerer et al., 1993; Lusk & Hudson, 2010).

Camerer et al. (1993) conduct a three-stage alternating-offer game, with one treatment framed as shrinking-gain, and the other as expanding-loss. Lusk and Hudson (2010) run a one-shot ultimatum game, asking subjects to either split a \$10 gain or a \$10 loss. Both studies find that players propose more to the responders when they are splitting losses than when they are splitting gains.

Note that in both of the above studies, subjects receive some endowments before they play the game in the loss treatment so the two treatments are equivalent in terms of net profit, while our subjects need to earn their endowments. Our earned-endowment procedure helps to frame the bargaining task to follow in the loss domain, and at the same time create a sense of entitlement and thus move people away from the equality focal point.

2.3 Gender Differences in Bargaining

While there are many studies on gender differences in preferences (Eckel & Grossman, 2008; Croson & Gneezy, 2009), surprisingly few studies look at gender differences over loss domain. One difference that has been studied is that of risk attitude. It is typically found that women are more risk averse than men over gains, but over losses, the results are mixed (Eckel & Grossman, 2002; Schubert et al., 1999; Fehr-Duda et al., 2006).

Gender differences in bargaining seem to be highly context-dependent (see Bertrand (2011) for a review). For example, two of the earlier lab studies find different gender patterns in ultimatum games. Solnick (2001) conducts a one-shot strategy method ultimatum game, and finds that average offers made do not differ based on the gender of the proposer. Eckel and Grossman (2001) use a repeated game method and a face-to-face design, where a group of four proposers is seated facing a group of four responders. Their data show that women's proposals are on average more generous than men's.

Small, Gelfand, Babcock, and Gettman (2007) investigate which gender is more likely to initiate negotiation, and find that women ask less often than men. Offering the negotiability of the payment does not reduce the gap, but framing the situation as an opportunity to "ask" rather than "negotiate" closes the gap. Dittrich, Knabe, and Leipold (2014) run a laboratory wage negotiation game and find that women obtain worse bargaining outcomes than men when they act as employees, but not as employers. Finally, Leibbrandt and List (2014) find that when wage negotiations are ambiguous, men are more likely to negotiate for higher wages than women; but when the negotiation is explicit this difference disappears completely.

3 Theoretical Model

Our experiments are based on the complete information stochastic bargaining framework developed by Merlo and Wilson (1995). The MW model extends the basic Rubinstein (1982) noncooperative sequential bargaining game to a k-player($k \geq 2$) stochastic environment, which allows the surplus to be allocated and the identity of the proposer to follow a general Markov process.

The solution concept we focus on here is that of Stationary Subgame Perfect Equilibrium (SSPE), in which the actions prescribed at any history in the strategy profile depend only on the current state and current offer. As is argued by Merlo and Wilson (1995), a SSPE may be the natural focal point of simple learning rules, and can serve as a first step towards studying the entire set of Subgame Perfect equilibria.

In our paper, we employ a simple version of the MW model, with two players $i = 1, 2$ and four states $S = \{s_1, s_{21}, s_{22}, s^*\}$. The cake $C(s)$ describes the set of possible utility vectors to be agreed upon in state s, and $\rho(s)$ denotes the order in which the players move, with $\rho_i(s)$ representing the identity of the player who makes the i^{th} move in that state.

Our two-stage game is played as follows. In stage 1, the initial state s_1, where player 1 is the proposer (i.e. $\rho_1(s_1) = 1$), is realized. Player 1 chooses to either pass or propose an allocation in $C(s_1)$. If she proposes an allocation, player 2 responds by either accepting or rejecting the proposal. An acceptance ends the game with the agreed-upon payoffs. If no proposal is offered and accepted, a new state is realized in stage 2, which can either be s_{21} or s_{22} with equal probability. Player i proposes in state s_{2i}, $i = 1, 2$ (i.e. $\rho_1(s_{2i}) = i$) and the proposal must lie in the set $C(s_{2i})$. If no proposal is accepted in stage 2, the game enters an absorbing state s^* where $C(s^*) = \{0\}$. In other words, if the two players do reach an agreement during the two stages, both of them get nothing.

The cake is the same in states s_1, s_{21} and s_{22} before time discounting (i.e. $C(s_1) = C(s_{21}) = C(s_{22}) := C(s)$). β is a (compound) common discount factor that captures both impatience of the players and change of the cake size. $\beta < 1$ means the discounted stage

2 cake is smaller than the stage 1 cake, and $\beta > 1$ means the discounted stage 2 cake is bigger.[2] Figure 1 depicts the game tree.

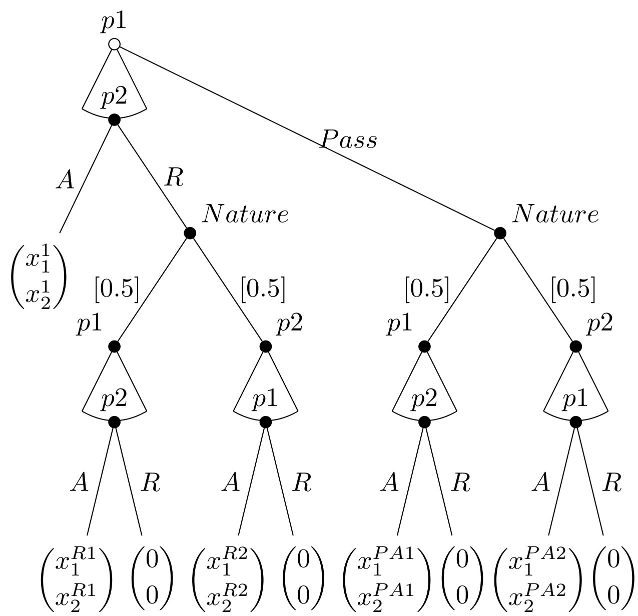


Figure 1: Game tree. Notes: Numbers in parentheses are payoffs to player 1 (top) and player 2 (bottom). $(x_1^1, x_2^1) \in C(s_1)$. (x_1^{R1}, x_2^{R1}) and $(x_1^{PA1}, x_2^{PA1}) \in \beta C(s_{21})$. (x_1^{R2}, x_2^{R2}) and $(x_1^{PA2}, x_2^{PA2}) \in \beta C(s_{22})$.

By changing the cake process $C(s)$ and the discount factor β, we construct four scenarios in which the SSPE vary by the timing of agreement and Pareto efficiency (see Table 1 and Table 2). Timing of agreement can be either immediate (agreement reached in stage 1) or delayed (agreement reached in stage 2). The (Pareto) efficiency here is an ex ante concept that only compares the expected payoffs of the different outcomes at the initial state. An outcome is Pareto optimal if there is no other outcome, in terms of payoff allocation and timing of agreement, which can attain a higher expected payoff for both players in stage 1.

The four games and available allocations are illustrated in Figure 2. The two axes show the payoffs to player 1 and player 2 under each allocation respectively. To make the games more accessible to the subjects, we select nine allocations on the budget line for them to

[2] This notation helps us to control the discounted change in cake size directly from the parameter β. Equivalently, we can specify two different cakes in each stage, and use a (simple) discount factor β $(0 < \beta < 1)$ that only captures impatience.

Table 1: Four Scenarios of Games in terms of SSPE Timing and Efficiency

SSPE	Efficient	Inefficient
Immediate Agreement	Game 1 (IAe)	Game 2 (IAi)
Delayed Agreement	Game 3 (DAe)	Game 4 (DAi)

Table 2: Discount Factor and Cake Process for Each Game

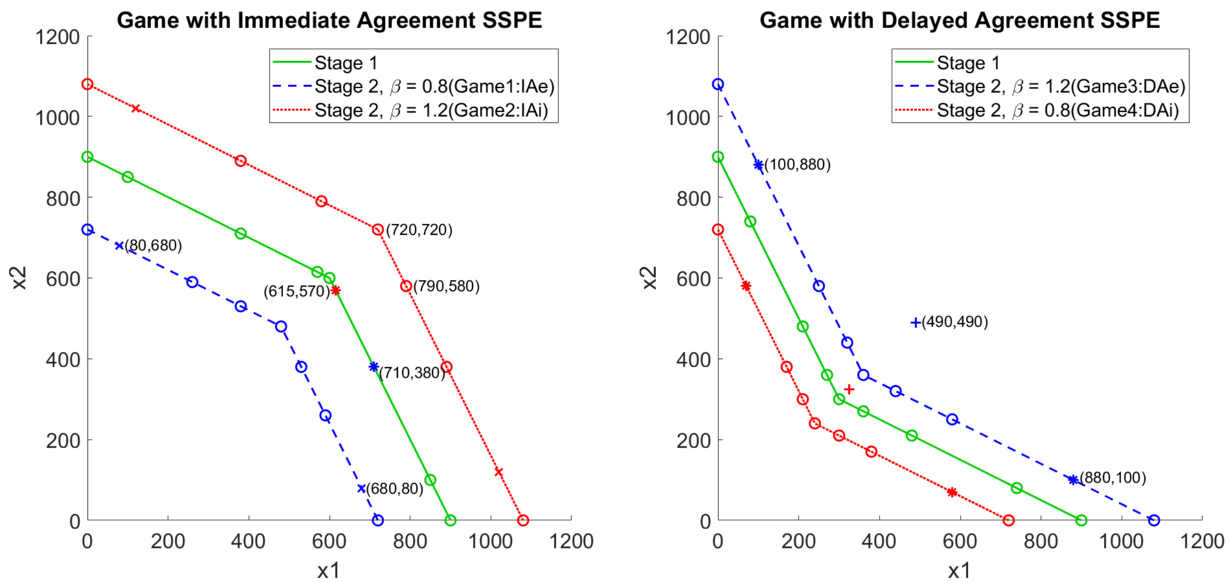
	Discount Factor β	Cake Process
Game 1 (IAe)	0.8	Stage 1: $C(s) = \{x \in R_+^2 : 2x_1 + x_2 \leq 1800 \text{ and } x_1 + 2x_2 \leq 1800\}$ Stage 2 (discounted): $\beta C(s) = \{x \in R_+^2 : 2x_1 + x_2 \leq 1800\beta \text{ and } x_1 + 2x_2 \leq 1800\beta\}$
Game 2 (IAi)	1.2	
Game 3 (DAe)	1.2	Stage 1: $C(s) = \{x \in R_+^2 : 2x_1 + x_2 \leq 900\} \cup \{x \in R_+^2 : x_1 + 2x_2 \leq 900\}$ Stage 2 (discounted): $\beta C(s) = \{x \in R_+^2 : 2x_1 + x_2 \leq 900\beta\} \cup \{x \in R_+^2 : x_1 + 2x_2 \leq 900\beta\}$
Game 4 (DAi)	0.8	

* Notes: $x = (x_1, x_2)$ denotes an allocation, where x_i is the payoff to player i. In our settings, the discount factor β not only captures impatience but also incorporates the change of the cake size: if $0 < \beta < 1$, the discounted stage 2 cake is smaller than stage 1, indicating a shrinking cake process; if $\beta > 1$, the discounted stage 2 cake is larger than stage 1, indicating an expanding cake process.

choose from in the experiment. Figure 2a depicts Game 1 and Game 2 where the two players agree immediately in stage 1 in SSPE. The stage 1 budget lines are the same for Game 1 and Game 2 (depicted in solid green line), while in stage 2, the discounted budget line of Game 1 shrinks towards the origin (depicted in dashed blue line), indicating a shrinking cake, and the discounted budget line of Game 2 expands against the origin (depicted in dotted red line), indicating an expanding cake. Figure 2b shows Game 3 and Game 4 where the two players delay agreement to stage 2 in SSPE. Similarly, the stage 1 budget lines in Game 3 and Game 4 are the same, and the stage 2 lines differ depending on the value of the discount factor.

To solve for the SSPE for each game, we apply backward induction and make the following three assumptions.

1. All players have selfish and risk-neutral preferences, where utility equals to the indi-



(a) Game 1 and Game 2 (b) Game 3 and Game 4

Figure 2: Four Games and Available Allocations (E\$) in Our Experiment (available allocations marked with o,$*$ and $\times$). Notes: The two axes show payoffs to player 1 (x_1) and player 2 (x_2) respectively. $*$ depicts equilibrium, $\times$ depicts equilibrium path, o depicts other available choice, $+$ depicts unattainable reservation payoff; all payoffs in discounted terms. For a complete list of the allocation payoffs, see Table 9 and Table 10 in Appendix.

vidual payoff.

2. The players need to receive at least some positive amount to accept. In other words, they reject a zero offer.

3. The players agree immediately whenever they can attain the SSP payoff.

Note that in a SSPE, the proposer obtains all of the surplus in excess of the other players' expected continuation payoff. Once the players are in stage 2, there is no continuation payoff. So the proposer in stage 2 proposes the least positive amount available to the responder and keeps the rest, and the responder accepts. In Game 1, for example, because in stage 2 either player 1 or player 2 will be the proposer with an equal chance, the players will end up at $(680, 80)$ or $(80, 680)$ (marked with "$\times$") if they enter stage 2. In stage 1, the reservation payoff for each player is the discounted expected payoff from the future stages. The reservation payoff equals 380 ($= 0.5 \times 680 + 0.5 \times 80$) for each player. Consequently, player 1, the proposer in stage 1, extracts from player 2, the responder in stage 1, all the surplus in excess of her reservation payoff and proposes $(710, 380)$ (marked with "*") in stage 1, and the responder accepts. For Game 1, in equilibrium, the two players agree immediately in stage 1 at $(710, 380)$. This SSPE is Pareto efficient, because there is no other allocation in stage 1 or stage 2 of Game 1 that makes both of the players better off. Similarly, we derive the SSPE for Game 2, which is an immediate agreement at $(615, 570)$ in stage 1. The SSPE for Game 2 is Pareto inefficient, because by waiting until stage 2, both players can be better off at $(720, 720)$ or $(790, 580)$, though these two allocations are not on the equilibrium path.

For Game 3 and Game 4, no allocation where both players get at least their reservation payoff is attainable on the stage 1 budget line. In Game 3, for example, in equilibrium, the two players agree on $(880, 100)$ or $(100, 880)$ in stage 2, and thus in stage 1, the reservation payoff for each player is $(490, 490)$ (marked with "+") and is way beyond the stage 1 budget line. As a result, the two players reach no agreement in stage 1 and wait until stage 2 when the uncertainty about their relative bargaining power is resolved. For Game 3, in equilibrium, the two players delay agreement to stage 2 at either $(880, 100)$ or $(100, 880)$, depending on who is the proposer in stage 2. The (Pareto) efficiency of the SSPE can be derived in the same way as noted earlier.

4 Experimental Design

Each session consists of two tasks and a survey. Task 1 is a real-effort encoding task, adapted from Erkal, Gangadharan, and Nikiforakis (2011) and Anbarci and Feltovich (2016)[3]. In Task 1, subjects see "words" which are sequences of four to six letters on the computer screen, one at a time. In addition, the computer provides a key showing the number corresponding to each letter in the alphabet. Their task is to type the number that corresponds to each letter in the word in the boxes below the word. They are given 10 minutes to encode as many words as possible, and the number of words correctly encoded determines who is the

[3]We thank Nick Feltovich for providing the z-tree program based on which we create our Task 1.

first mover in Task 2. They need to encode at least 20 words correctly in order to proceed to Task 2 and receive payment. The instructions also state that in case any subject fails to meet that requirement, she will be given extra time to finish, but that never happened in the experiment.

Task 1 serves two purposes. First and foremost, it determines each subject's bargaining power in the main bargaining task that follows. Secondly, it helps to mitigate the house money effect[4], by making subjects earn their way to the bargaining games, as well as earn their endowment in the Loss treatment, which will be explained later.

Task 2 is the stochastic bargaining games. Subjects play 16 rounds of the MW games described in Section 3 and get paid for four randomly-chosen rounds with a conversion rate of 25 Experimental Dollars (E$) = $1. They do not see which rounds are chosen for payment or how much they earn until the end of the experiment. The 16 rounds are divided into four blocks, with each block containing the four games (Game 1(IAe), Game 2(IAi), Game 3(DAe) and Game 4(DAi)) in a random order. So subjects play each game for four times.

At the beginning of each round, two subjects are randomly matched to be counterparts for each other. The person in a pair who encoded more words in Task 1 will be Player 1, and the other Player 2. Ties are resolved by the computer with a coin flip. The two players in a pair then need to decide the amount of gain that each of them receives for the round. In stage 1, player 1 makes a proposal (from the nine available options) and player 2 then chooses to accept or reject. If the proposal is accepted, the round ends and the two players earn the proposed payoffs. If the proposal is rejected or player 1 chooses to pass, the players proceed to stage 2. In stage 2, both players are equally likely to be the proposer. After the computer randomly decides the proposer in stage 2, that proposer proposes an allocation (from another nine available options) and the other player decides whether to accept or reject. If the proposal is accepted, the two players earn the agreed-upon payoffs. If it is

[4]The house money effect refers to the tendency that participants in a game might behave differently when using their own money than when using the money given by the experimenter at the time of decisions (Thaler & Johnson, 1990; Houser & Xiao, 2015).

rejected, both of them get zero. After they see what they earn for the round, a new round begins, and the subjects are randomly rematched.

We apply random matching[5] between rounds to eliminate reciprocity and reputation building. In stage 1 of the round, subjects see the nine alternative proposals for stage 1, as well as the nine that would be available for stage 2. When they enter stage 2, they only see the stage 2 alternatives, but no longer the stage 1 alternatives. This is a complete information game, and both players in a pair see the same information on the screen.

We ran two treatments in total. Our Gain treatment follows the protocol described above. The Loss treatment is similar to the Gain treatment except for two features. First, in Task 1, the subjects receive E$54 for each of the first 20 words correctly encoded, which ensures that, at the beginning of Task 2, everyone starts with E$1080. Second, instead of gains, subjects now bargain over losses in Task 2. Although everything is framed in loss domain, the net payoffs, which equal endowments minus amount of losses, in each available proposal are the same as those in the Gain treatment. For example, the equal split in stage 1 of Game 1 is now $(-480, -480)$ in the Loss treatment, instead of $(600, 600)$ in the Gain treatment. The proposal of $(680, 80)$, favoring player 1 in stage 2 of Game 1 in the Gain treatment becomes $(-400, -1000)$ in the Loss treatment. For a whole list of the alternative allocation proposals in the two treatments, see Table 9 and Table 10 in Appendix.

Each session proceeds as follows. Upon arrival, all subjects are randomly seated to the computer terminals. Subjects are told at the beginning that their performance in Task 1 will directly affect their position in Task 2, and will in turn determine the final payoff. Instructions for Task 1 are distributed at the beginning, while instructions for Task 2 are not distributed until the subjects finish Task 1. We do this to create a feeling of ownership of the money they earn in Task 1 for the Loss treatment. In fact, some subjects in the Loss treatment did say in the survey they were surprised by the splitting loss task. Before each task, we first read aloud the instructions for that part, distribute a quiz and walk them

[5]Participants do not know exactly who they are matched with, but one can be matched with the same person for more than once.

through two practice rounds to make sure they understand the rules and how to perform the tasks on the computer. Following this, the paid tasks begin.

After they finish Task 2, they are directed to a survey including two incentivized risk preference multiple price lists, one in the gain domain and one in the loss domain (see Table 11 and 12 in Appendix), as well as some demographic questions and thoughts regarding the experiment. Once they finish the survey, they see their final earnings on the screen, and are then paid privately in cash.

We conducted all experiments at the ICES lab at George Mason University. All subjects are Mason students, and no one participated in more than one experimental session. We ran 8 sessions for each of the two treatments, with 12 subjects per session. A total of 192 subjects participated, among which 83 are males and 109 are females. Including a $5 show-up fee, subjects earned an average of $23 for a 100-minute session. The experiment was programmed using Z-tree (Fischbacher, 2007). Table 3 displays summary statistics. Instructions, screenshots and survey questions are available in the Online Appendices[6].

Table 3: Summary Statistics

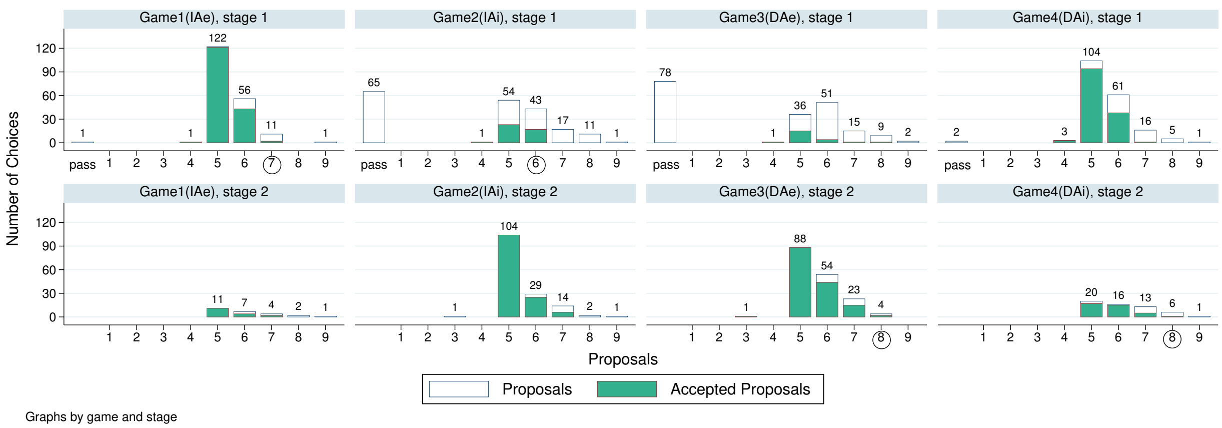
	Number of obs.	Mean	Std. Dev.	Min.	Max.
Female	192	.57	.50	0	1
Gain treatment	96	.57	.50	0	1
Loss treatment	96	.56	.50	0	1
Age	192	20.35	2.25	18	32
Year of College	192	2.45	1.09	1	5
Words Encoded in Task 1	192	48.09	7.58	29	75
Risk Aversion in Gain Domain	192	2.66	1.32	0	5
Risk Aversion in Loss Domain	192	2.52	1.16	0	5
General Risk	192	5.96	2.14	0	10
Payoff from Task 2 ($)	192	17.63	4.36	7	27
Player 1 Round Payoff (E$)	1,536	453.23	213.31	0	1020
Gain treatment	768	454.43	210.21	0	890
Loss treatment	768	452.04	216.50	0	1020
Player 2 Round Payoff (E$)	1,536	434.22	211.97	0	890
Gain treatment	768	435.95	211.11	0	890
Loss treatment	768	432.49	212.95	0	890

[6]Available at http://shuwenli.com/research/.

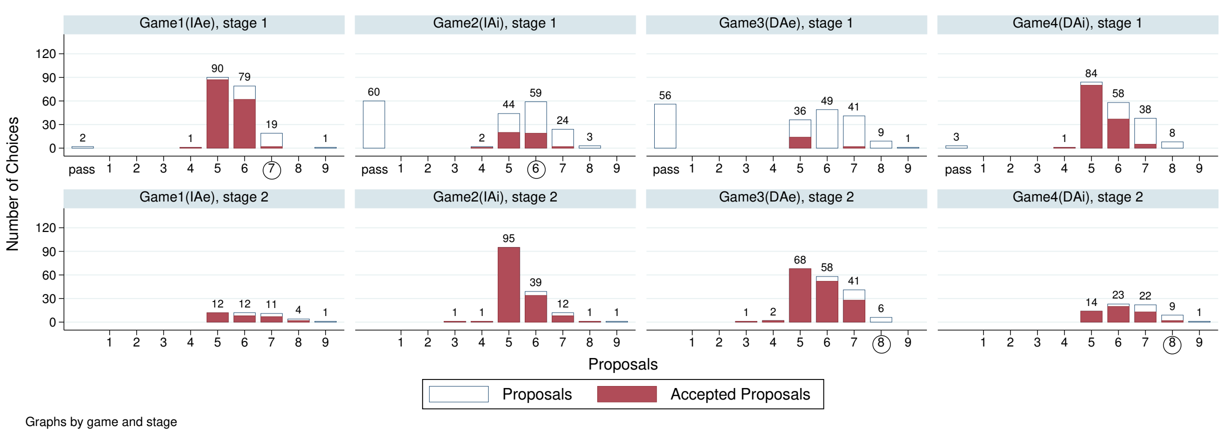
5 Results

5.1 Data Overview

The distributions of the proposers' choices, along with the distributions of agreements, at each stage of the four games in each treatment are depicted in Figure 3. Recall that in each stage, there are nine alternatives, numbered from 1-9, with the responder's payoff decreasing and the proposer's payoff increasing. Alternative 5 is the equal split. A complete list of the choices is included in the Appendix.



(a) Gain Treatment



(b) Loss Treatment

Figure 3: Numbers of Proposals and Accepted Proposals in Each Treatment. Notes: SSPE marked with circle. From alternative 1 to alternative 9, the proposer's payoff is increasing, and the responder's payoff is decreasing. Alternative 5 is the equal split. Number of observations in stage 1 of each game = 192.

The subjects' choices display the following general patterns.

1. Most proposers make equal offers or unequal offers that favoring themselves.

2. Subjects do not behave according to the SSPE predictions. Not many proposals, not to mention agreements, occur at the SSPE of each game, which are marked with circle in the figure.

3. Subjects respond to the Pareto efficiency of the allocations. They tend to agree more in the stage where the allocations are Pareto efficient.

4. In the stages where subjects do reach agreement, especially in the Gain treatment, a majority of proposals are equal splits, and are mostly accepted.

Figure 4 shows the differences in number of proposals and agreements for a better comparison between treatments. It seems that in most stages, subjects in the Loss treatment are less likely to choose equal split (alternative 5) than those in the Gain treatment; they are more likely to choose a proposal that gives themselves more than their counterpart in the Loss treatment instead. Differences in agreements show the same pattern.

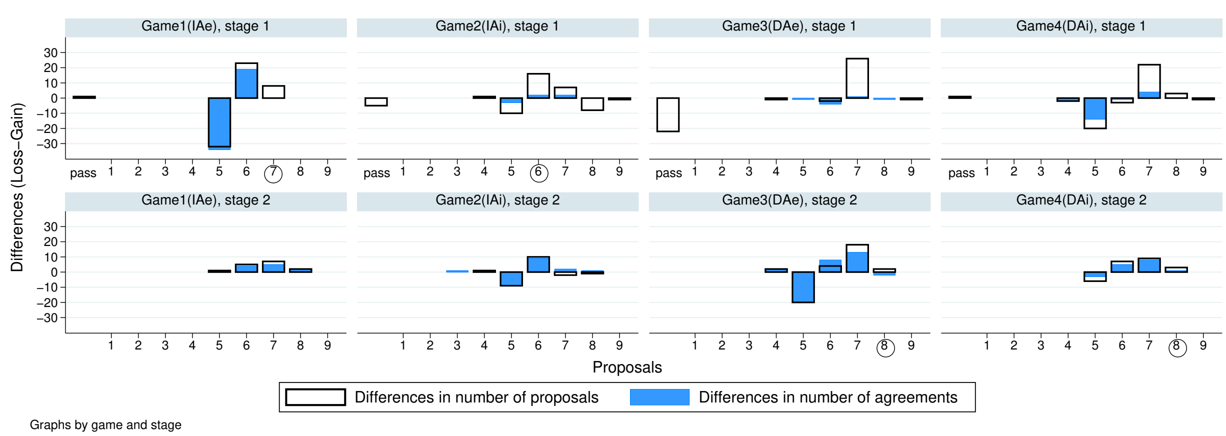


Figure 4: Differences in number of proposals and agreements (Loss treatment - Gain treatment). Notes: SSPE marked with circle. From alternative 1 to alternative 9, the proposer's payoff is increasing, and the responder's payoff is decreasing. Alternative 5 is the equal split.

5.2 Roles of the Stationary Subgame Perfect Equilibria

It seems that subjects care a lot about efficiency in this experiment, and after they achieve efficiency, they think about equality. This is, however, not the whole story. The SSPE does play an important role in determining subjects' behavior, although in a less obvious way.

To formally test the roles of the SSPE, we introduce two features of the stages: whether the SSPE is in the stage, and whether the stage is Pareto efficient. Recall that the four games differ in the timing and efficiency of the SSPE. In our case, because the cake is the same in the two stages of the game, if the SSPE is not efficient, it is in the stage with a smaller (discounted) cake. In other words, choices in the other stage are Pareto efficient because they are on a bigger (discounted) cake. We call the stage with a bigger discounted cake Pareto efficient stage. We can now describe the four games by a combination of two features of the stages, which is essentially equivalent as reflected by the SSPE. For example, in Game 1, stage 1 has the SSPE in the stage, and stage 1 is Pareto efficient. This means Game 1 has a SSPE with immediate agreement and is efficient. The two features of the stages for each game are listed in Table 4.

Table 4: Two Features of the Stages for Each Game

		SSPE in stage	Stage Pareto efficient
Game1 (IAe)	Stage 1	✓	✓
	Stage 2	✗	✗
Game2 (IAi)	Stage 1	✓	✗
	Stage 2	✗	✓
Game3 (DAe)	Stage 1	✗	✗
	Stage 2	✓	✓
Game4 (DAi)	Stage 1	✗	✓
	Stage 2	✓	✗

We first look at what features of the stage subjects care about when they reach an agreement. Since this is a two-stage game, players in a pair do not only think about what to choose in a single stage, but take the two stages as a whole to decide when is the best time to reach an agreement.

Observation 1: In both treatments, agreements are significantly more likely to occur in a Pareto efficient stage or a SSPE stage, with the former having an effect about five times of the latter.

Table 5: SSPE and Stage Efficiency on Agreement Pattern

Dependent variable: AgreementInStage		
Sample:	All bargaining rounds	
	(1)	(2)
SSPE stage	0.112***	0.112***
	(0.0191)	(0.0191)
Pareto efficient stage	0.586***	0.586***
	(0.0227)	(0.0227)
Loss treatment		-0.00260
		(0.0133)
Block dummies	no	yes
Constant	0.109***	0.111***
	(0.0130)	(0.0188)
No. of observations	3072	3072
R^2	0.358	0.358

* Notes: OLS regression with clustering at the individual subject level. Robust standard errors in parentheses. Significant levels are indicated by $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$. Dependent variable *AgreementInStage* = 1 if a proposal is accepted in the stage for a given pair; = 0 otherwise. Independent variables *SSPE stage* equals 1 if the SSPE is in the stage and 0 otherwise; *Pareto efficient stage* equals 1 if the stage is Pareto efficient and 0 otherwise. Control variables include *Loss treatment*, equal to 1 if in the Loss treatment and 0 in the Gain treatment and block dummies for each four-game time blocks.

Table 5 shows the OLS regression results on agreement pattern. An agreement means that the responder accepts the proposal made by the proposer in a stage. No agreement is reached if a proposal is rejected or the proposer chooses to pass. In addition, if an agreement is reached in stage 1 of a round, there is no agreement in stage 2 because the players do not enter stage 2. For each pair of the players in a given round, we are able to observe whether an agreement is reached in stage 1 or stage 2, or neither(meaning a bargaining breakdown).

The dependent variable *AgreementInStage* is a dummy variable which equals 1 if the pair reaches an agreement in the stage, and 0 otherwise. Thus, for each pair of players in one bargaining round there are two observations, one for stage 1 and one for stage 2. We use two dummy variables for each feature of the stage: *SSPE stage*, which equals 1 if the SSPE is in the stage and 0 otherwise, and *Pareto efficient Stage*, which equals 1 if the stage is Pareto efficient and 0 otherwise.

In model (1) of Table 5, when a stage contains the SSPE, players in a pair are 11.2% more likely to reach an agreement compared with a stage that does not contain the SSPE. When a stage is Pareto efficient, players are 58.6% more likely to reach an agreement. Both features of the stage significantly matter for agreement in the stage, while efficiency of the stage has a much bigger magnitude. The results do not change when we control for treatment and time blocks in model (2). Players are equally likely to reach agreement in the two treatments. The efficiency of the stage has a positive effect on possibility of agreement about five times of that caused by the fact that the SSPE is in the stage.

Next, we investigate whether the SSPE has a pulling effect on the proposals. Since we observe a big proportion of equal splits, especially in the Pareto efficient stages where subjects do reach agreement, we would like to test whether existence of the SSPE pull proposers from equality to more selfish proposals.

Observation 2: In the efficient stages where agreements do occur, proposers are significantly more likely to make a proposal favoring themselves when a SSPE exists in the stage than when there is not.

Table 6 shows the OLS regression results on the proposals. The dependent variable *MoreToSelf* is a dummy variable indicating whether a proposal chosen by the proposer favors herself than the responder. It equals 1 if the proposer gives more to herself, and 0 if the proposer chooses an equal split or gives less to herself. The core covariates *SSPE stage* and *Pareto efficient stage* are the same as above.

Table 6: SSPE and Stage Efficiency on Proposals

Dependent variable: MoreToSelf				
Sample:	All stages		Pareto efficient stages	
	(1)	(2)	(3)	(4)
SSPE stage	0.0281	0.0270	0.0650***	0.0593**
	(0.0197)	(0.0195)	(0.0242)	(0.0241)
Pareto efficient stage	-0.214***	-0.208***	-	-
	(0.0258)	(0.0262)		
Loss treatment		0.116**		0.123**
		(0.0508)		(0.0523)
Female		-0.117**		-0.102*
		(0.0505)		(0.0526)
Block dummies	no	yes	no	yes
Constant	0.654***	0.670***	0.421***	0.473***
	(0.0343)	(0.0545)	(0.0294)	(0.0562)
No. of observations	2106	2106	1407	1407
R^2	0.042	0.070	0.004	0.035

* Notes: OLS regression with clustering at the individual subject level. Robust standard errors in parentheses. Significant levels are indicated by $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$. Dependent variable *MoreToSelf* = 1 if the proposer chooses a proposal that gives strictly more to herself; = 0 otherwise. Independent variables *SSPE stage* equals 1 if the SSPE is in the stage and 0 otherwise; *Pareto efficient stage* equals 1 if the stage is Pareto efficient and 0 otherwise. Control variables include *Loss treatment*, equal to 1 if in the Loss treatment and 0 in the Gain treatment, *Female*, equal to 1 if the proposer is a female and 0 otherwise, and block dummies for each four-game time blocks. Proposers' choices of "pass" are excluded.

In Table 6, model (1) and (2) include proposals that are not "pass" in all stages. Proposers are about 20% less likely to propose strictly more to themselves in a Pareto efficient stage. This is consistent with the agreement clusters at equality in stages where most agreements occur. The pulling effect of the SSPE is small and not significant. However, expecting that it is unlikely to reach agreement in some stages, proposers are less likely to take the proposals seriously there. When we restrict the sample to proposals in model (3) and (4), excluding "pass", in the four Pareto Efficiency stages where subjects do reach agreement, we see a statistically significant positive effect of the SSPE on the proposals: proposers are about 6% more likely to be more selfish than in a stage that does not contain SSPE.

Observation 3: Proposers are significantly more selfish in the Loss treatment than the Gain treatment.

Observation 4: Male proposers are significantly more likely to suggest more for themselves than female proposers.

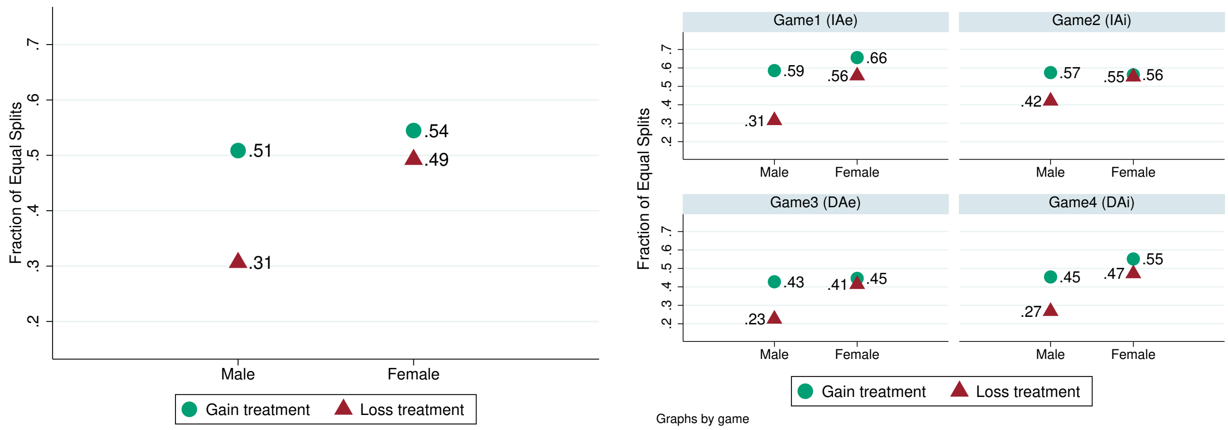
We also find that in the Loss treatment, proposers are about 12% significantly more likely to select a proposal with more to himself compared with in the Gain treatment. Females are about 11% significantly less likely to favor themselves compared with males. We will take a closer look at gender differences later.

5.3 Gender Differences in Equal Splits

Now we turn to analyze the gender differences in these bargaining environments. We find no significant gender differences as responders: males and females are equally likely to accept a given proposal, in either the Gain or Loss treatment (see Table 13 in Appendix). We focus on the proposer behavior from now on.

One common finding in the experimental literature is that women are more inequality averse than men (e.g. Andreoni and Vesterlund (2001); Dufwenberg and Muren (2006); Fehr, Naef, and Schmidt (2006); Güth, Schmidt, and Sutter (2007); see Croson and Gneezy (2009) for a review). Since a considerable number of proposals are equal splits in our data, it is natural for us to test gender preferences on equality. To do this, we categorize nonpass proposals into two types: equal split (a proposal of alternative 5 in any stage) or non-equal split (a proposal of other alternatives). We pool the stage 1 and stage 2 proposals in a game because we are interested in its qualitative feature (equal split or not), but not its absolute payoffs. Figure 5 illustrates fractions of equal splits out of the total proposals made by males and females in each treatment. A more sophisticated analysis is presented in Table 7.

Since subjects played two practice rounds before the real games, and the rules of game are not very complicated, we assume most learning occurs at the practice rounds. We also check the dynamics of equal choices over time using regressions and find no time dependence (see Figure 6 and Table 14 in Appendix). We thus pool the equal splits in different rounds in the following analyses.



(a) Fractions of Equal Splits All Games

(b) Fractions of Equal Splits by Games

Figure 5: Fractions of Equal Splits by Treatment and Gender.

Observation 5: Gender differences on equal splits only exist in the loss domain, with male proposers significantly less likely to propose equality.

Table 7 shows OLS regression results of treatment effects on choices of equal splits and gender differences. The dependent variable *EqualSplit* equals 1 if the proposal chosen gives equal payoff to both players, and 0 otherwise. The main independent variables are *Loss*, a dummy variable which equals 1 for the Loss treatment and 0 for the Gain treatment and *Female*, a dummy variable which equals 1 for female proposer and 0 for male proposer.

Models (1)- (2) include nonpass proposals in all stages. Model (1) shows that proposers are 12.4% significantly less likely to propose equality in the Loss treatment than the Gain treatment. Female proposers are 11% more likely than male proposers to choose equality. In model (2) we add an interaction term between *Loss* and *Female* to see whether the treatments have different effects on males and females. Results show that the Loss treatment has a significant effect on male proposers' choices: males are 20% significantly less likely to choose an equal split in the Loss treatment than in the Gain treatment. Female proposers in the Gain treatment do not significantly differ from male proposers in terms of probability of choosing equality. In the loss domain, females are about 18.5% significantly more likely to propose equality than males ($F(1, 191) = 7.68, Prob > F = 0.0061$). The Loss treatment has

Table 7: Treatment Effects and Gender Differences on Equal Splits

	Dependent variable: EqualSplit			
Sample:	All stages		Pareto efficient stages	
	(1)	(2)	(3)	(4)
Loss	-0.124**	-0.202***	-0.125**	-0.187**
	(0.0523)	(0.0737)	(0.0529)	(0.0776)
Female	0.113**	0.0361	0.0980*	0.0397
	(0.0521)	(0.0784)	(0.0531)	(0.0766)
Loss × Female		0.150		0.117
		(0.103)		(0.105)
Constant	0.471***	0.509***	0.548***	0.576***
	(0.0484)	(0.0578)	(0.0479)	(0.0561)
No. of observations	2106	2106	1407	1407
R^2	0.026	0.032	0.023	0.027

* Notes: OLS regression with clustering at the individual subject level. Robust standard errors in parentheses. Significant levels are indicated by $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$. Dependent variable *EqualSplit* = 1 if the proposal chosen gives equal payoff to both players; = 0 otherwise. Independent variables *Loss* equals 1 if in the Loss treatment and 0 in the Gain treatment; *Female*, equal to 1 if the proposer is a female and 0 otherwise. Proposers' choices of "pass" are excluded.

almost no effect on females' generosity: female proposers are only 5.2% less likely to choose an equal split in the Loss treatment compared with the Gain treatment, and the difference is statistically insignificant ($F(1, 191) = 0.52, Prob > F = 0.4708$). This means that males become much more selfish when splitting losses than gains, while females do not respond to the domain of the cake.

In model (3) and (4), we restrict the sample to the proposals in the four Pareto efficient stages where most agreements occur. The above results still hold. In loss domain, males are 18.7% significantly less likely to choose an equal proposal, while females do not significantly change their frequency of equal choice ($F(1, 191) = 0.94, Prob > F = 0.3327$).

We then repeat the same analyses on each of the four games separately, and we find the same patterns (see Table 15 in Appendix). The preference differences of males and females towards gains and losses are systematic across different types of games.

5.4 Risk Attitudes on Equal Splits

A possible explanation of the gender differences in equal splits observed above is risk attitude. Women are generally more risk averse than men. In our game, proposers face two types of risks. First, as a proposer, one might be rejected by the responder. Second, for the proposer in stage 1, if she is rejected, the pair proceeds to stage 2 and she might lose the advantage of proposing. When facing these risks, a female proposer may want to propose something equal to guarantee an acceptance in her hand.

To test whether risk attitudes can be the mechanism, following Dohmen et al. (2011), we use two different risk measurements: *General risk*, a self-assessed measure of general risk aversion on a 0-10 point scale, with 0="Not at all willing to take risks" and 10="Very willing to take risks", and two lottery-based risk attitudes *Risk in gain domain* and *Risk in loss domain*, both from 0 to 5. Subjects are presented with two incentivized Holt and Laury (2002) style multiple price lists (MPL): one with five choices between a gain lottery and a sure gain, and the other with five choices between a loss lottery and a sure loss (see Table 11 and 12 in Appendix). The number of safe choices in each list measures their risk attitude. A greater *Risk in gain domain* or *Risk in loss domain* means more risk averse in the corresponding domain.

Observation 6: Risk attitudes cannot explain the gender differences observed.

Results regarding risk attitudes are shown in Table 8. Control for general risk attitudes in model (1) and (2), male proposers are still about 17% significantly less likely to propose equality in the Loss treatment, and female proposers still do not significantly reduce their choices of equality when facing losses ($F(1, 191) = 0.6, Prob > F = 0.44$). As expected, *General risk* is negative, meaning that instead of proposing a "safe" equal split, more risk loving proposers are more likely to go for selfish allocations, but is not significant.

Model (3) and (4) look at each domain separately, because *Risk in gain domain* should only matter for the Gain treatment, and *Risk in loss domain* for the Loss treatment. As

Table 8: Risk Attitudes on Equal Splits

Dependent variable: EqualSplit					
Sample:	All stages		Gain treatment	Loss treatment	Pareto efficient stages
	(1)	(2)	(3)	(4)	(5)
Loss	-0.177**	-0.167**	-	-	-0.170**
	(0.0726)	(0.0744)			(0.0797)
Female	0.0334	0.0448	0.0256	0.167**	0.0424
	(0.0783)	(0.0773)	(0.0790)	(0.0704)	(0.0778)
Loss × Female	0.122	0.111			0.0985
	(0.101)	(0.100)			(0.105)
General risk	-0.0210	-0.0202			-0.0168
	(0.0143)	(0.0142)			(0.0142)
Risk in gain domain			0.0456		
			(0.0275)		
Risk in loss domain				0.0461	
				(0.0340)	
Year of college dummies	no	yes	no	no	yes
Constant	0.631***	0.620***	0.386***	0.197**	0.666***
	(0.108)	(0.106)	(0.0907)	(0.0852)	(0.108)
No. of observations	2106	2106	1024	1082	1407
R^2	0.039	0.045	0.013	0.044	0.036

[*] Notes: OLS regression with clustering at the individual subject level. Robust standard errors in parentheses. Significant levels are indicated by $^{*}p < 0.1,^{**}p < 0.05,^{***}p < 0.01$. Dependent variable *EqualSplit* = 1 if the proposal chosen gives equal payoff to both players; = 0 otherwise. Independent variables *Loss* equals 1 if in the Loss treatment and 0 in the Gain treatment; *Female*, equal to 1 if the proposer is a female and 0 otherwise; *General risk* is a 0-10 integer with 0="Not at all willing to take risks" and 10="Very willing to take risks"; *Risk in gain domain* and *Risk in loss domain* are 0-5 integer numbers with bigger number meaning more risk averse in the corresponding domain; *Year of college* are dummies indicating which year they are in. Proposers' choices of "pass" are excluded.

before, even controlling for risk attitudes in the corresponding domain, we still find that males and females are equally likely to propose equality in the gain domain, while females are 17% significantly more likely than males to choose equal splits in the loss domain. As expected, coefficients for both risk attitudes are positive, meaning a more risk averse proposer is more likely to choose an equal outcome, but again, not significant.

Model (5) restricts the sample to the four Pareto efficient stages where most agreements occur. The results in model (1) and (2) still hold here.

Results in Table 8 are similar to those in Table 7. This means that when we control for risk preferences, the gender differences are still there, with a same magnitude. There should be some fundamental differences in men and women other than risk attitudes that lead to the behavior gap in this setting.

6 Concluding Remarks

We provide the first experimental test of a two-player two-stage version of the Merlo and Wilson (1995) stochastic bargaining game where delays in agreement can occur in equilibrium and can be efficient. We examine behavior in both the gain and loss domains. We find most agreements are efficient and a considerable number are equal splits. Players do delay agreement if it is Pareto efficient to do so. Players are significantly more likely to reach agreement in stages that contain the SSPE. Further, proposals made in stages that include the SSPE are significantly more likely to be unequal in the direction of the SSPE outcome, and thus favor the proposer.

Proposers are on average significantly more selfish in the loss domain than gain domain, which is driven largely by male's different reactions in each domain. Male proposers are as likely to choose a fair split as female proposers when bargaining over gains. However, when splitting losses, males are significantly more aggressive, in that they are more likely to propose a greater loss to their counterpart and thus incur a smaller loss themselves. Females' behaviors do not differ significantly between domains, in that they are equally likely to propose equal splits in both the gain and loss domains. The differences between male and female behavior cannot be explained by risk attitudes.

Our findings provide three implications. First, the finding that proposers are more likely to choose allocations favoring themselves, i.e. behave more according to the equilibrium predictions, in the loss domain suggests that empirically, the MW model provides powerful approach to modeling bargaining over losses, such as may occur in debt renegotiations. Researchers need to exercise caution when applying this model to negotiations in the gain domain because there is little support of equilibrium predictions from the micro-foundation data.

Second, gender differences in this environment provide further evidence on the question "which is the fair sex". Andreoni and Vesterlund (2001) show that this question has a complicated answer, because men's demand curves for altruism are more price-elastic than women's. We discover an analogous phenomenon: men's demand curves for altruism are more domain-elastic, while women's are almost domain-inelastic. When it is about losses, women are fairer, but when it is about gains, men are equally fair.

Third, our finding that male proposers are significantly more selfish than female proposers when bargaining over losses may help to explain the persistent gender wage gap. Empirical studies find that women appear less likely to initiate negotiations (Babcock & Laschever, 2009; Gelfand & Stayn, 2013), and state lower wage bids when asked from their prospective employers, controlling for individual- and job-level characteristics (Säve-Söderbergh, 2007). While both genders have been shown to display overconfidence, men appear particularly overconfident in their relative ability (Beyer & Bowden, 1997; Barber & Odean, 2001). Thinking of themselves both over qualified for a position, and good at bargaining, men are more likely to set a higher reference wage than their prospective wage, compared with women with equal productivity. As a result, men may tend to perceive wage negotiations in loss domain. If this is the case, our finding would explain the reason why men appear to bargain more aggressively than women, which leads to part of the gender wage gap. It would be profitable for future research to explore this issue.

References

Agranov, M. & Tergiman, C. (2014). Communication in multilateral bargaining. *Journal of Public Economics*, *118*, 75–85.

Anbarci, N. & Feltovich, N. (2016). *How fully do people exploit their bargaining position? the effects of bargaining institution and the 50–50 norm.* Monash University, Department of Economics.

Andreoni, J. & Bernheim, B. D. (2009). Social image and the 50–50 norm: A theoretical and experimental analysis of audience effects. *Econometrica*, *77*(5), 1607–1636.

Andreoni, J. & Vesterlund, L. (2001). Which is the fair sex? gender differences in altruism. *The Quarterly Journal of Economics*, *116*(1), 293–312.

Babcock, L. & Laschever, S. (2009). *Women don't ask: Negotiation and the gender divide*. Princeton University Press.

Barber, B. M. & Odean, T. (2001). Boys will be boys: Gender, overconfidence, and common stock investment. *The quarterly journal of economics*, *116*(1), 261–292.

Baron, D. P. & Ferejohn, J. A. (1989). Bargaining in legislatures. *American political science review*, *83*(04), 1181–1206.

Bazerman, M. H., Magliozzi, T., & Neale, M. A. (1985). Integrative bargaining in a competitive market. *Organizational behavior and human Decision Processes*, *35*(3), 294–313.

Benjamin, D. & Wright, M. L. (2009). Recovery before redemption: A theory of delays in sovereign debt renegotiations.

Bertrand, M. (2011). New perspectives on gender. *Handbook of labor economics*, *4*, 1543–1590.

Beyer, S. & Bowden, E. M. (1997). Gender differences in self-perceptions: Convergent evidence from three measures of accuracy and bias. *Personality and Social Psychology Bulletin*.

Camerer, C. F., Johnson, E., Rymon, T., & Sen, S. (1993). Cognition and framing in sequential bargaining for gains and losses. *Frontiers of game theory*, *104*, 27–47.

Croson, R. & Gneezy, U. (2009). Gender differences in preferences. *Journal of Economic Literature*, 448–474.

Dhillon, A., García-Fronti, J., Ghosal, S., & Miller, M. (2006). Debt restructuring and economic recovery: Analysing the argentine swap. *The World Economy*, *29*(4), 377–398.

Diermeier, D., Eraslan, H., & Merlo, A. (2003). A structural model of government formation. *Econometrica*, *71*(1), 27–70.

Dittrich, M., Knabe, A., & Leipold, K. (2014). Gender differences in experimental wage negotiations. *Economic Inquiry*, *52*(2), 862–873.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., & Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, *9*(3), 522–550.

Dreu, C. d., Emans, B., Vliert, E., Carnevale, P., et al. (1994). Effects of gain-loss frames in negotiation: Loss aversion, mismatching, and frame adoption. *Organizational behavior and human decision processes*, *60*, 90–107.

Dufwenberg, M. & Muren, A. (2006). Gender composition in teams. *Journal of Economic Behavior & Organization*, *61*(1), 50–54.

Eckel, C. C. & Grossman, P. J. (2001). Chivalry and solidarity in ultimatum games. *Economic Inquiry*, *39*(2), 171–188.

Eckel, C. C. & Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and human behavior*, *23*(4), 281–295.

Eckel, C. C. & Grossman, P. J. (2008). Men, women and risk aversion: Experimental evidence. *Handbook of experimental economics results*, *1*, 1061–1073.

Eraslan, H. K. (2008). Corporate bankruptcy reorganizations: Estimates from a bargaining model. *International Economic Review*, *49*(2), 659–681.

Erkal, N., Gangadharan, L., & Nikiforakis, N. (2011). Relative earnings and giving in a real-effort experiment. *The American Economic Review*, *101*(7), 3330–3348.

Fehr, E., Naef, M., & Schmidt, K. M. (2006). Inequality aversion, efficiency, and maximin preferences in simple distribution experiments: Comment. *The American economic review*, *96*(5), 1912–1917.

Fehr-Duda, H., De Gennaro, M., & Schubert, R. (2006). Gender, financial risk, and probability weights. *Theory and decision*, *60*(2), 283–313.

Fischbacher, U. (2007). Z-tree: Zurich toolbox for ready-made economic experiments. *Experimental economics*, *10*(2), 171–178.

Frechette, G. R., Kagel, J. H., & Lehrer, S. F. (2003). Bargaining in legislatures: An experimental investigation of open versus closed amendment rules. *American Political science review*, *97*(02), 221–232.

Gelfand, M. & Stayn, H. (2013). Gender differences in the propensity to initiate negotiations. *Social psychology and economics*, 239.

Golder, S. N. (2010). Bargaining delays in the government formation process. *Comparative Political Studies*, *43*(1), 3–32.

Güth, W. & Kocher, M. G. (2014). More than thirty years of ultimatum bargaining experiments: Motives, variations, and a survey of the recent literature. *Journal of Economic Behavior & Organization*, *108*, 396–409.

Güth, W., Schmidt, C., & Sutter, M. (2007). Bargaining outside the lab–a newspaper experiment of a three-person ultimatum game. *The Economic Journal*, *117*(518), 449–469.

Hoffman, E., McCabe, K., Shachat, K., & Smith, V. (1994). Preferences, property rights, and anonymity in bargaining games. *Games and Economic behavior*, *7*(3), 346–380.

Hoffman, E. & Spitzer, M. L. (1985). Entitlements, rights, and fairness: An experimental examination of subjects' concepts of distributive justice. *The Journal of Legal Studies*, *14*(2), 259–297.

Holt, C. A. & Laury, S. K. (2002). Risk aversion and incentive effects. *The American Economic Review*, *92*(5), 1644–1655.

Houser, D. & Xiao, E. (2015). House money effects on trust and reciprocity. *Public Choice*, *163*(1-2), 187–199.

Kagel, J. H., Sung, H., & Winter, E. (2010). Veto power in committees: An experimental study. *Experimental Economics*, *13*(2), 167–188.

Kahneman, D. & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica: Journal of the econometric society*, 263–291.

Laver, M. & Benoit, K. (2015). The basic arithmetic of legislative decisions. *American Journal of Political Science*, *59*(2), 275–291.

Leibbrandt, A. & List, J. A. (2014). Do women avoid salary negotiations? evidence from a large-scale natural field experiment. *Management Science*, *61*(9), 2016–2024.

Lusk, J. L. & Hudson, M. D. (2010). Bargaining over losses. *International Game Theory Review*, *12*(01), 83–91.

Merlo, A. (1997). Bargaining over governments in a stochastic environment. *Journal of Political Economy*, *105*(1), 101–131.

Merlo, A. & Tang, X. (2012). Identification and estimation of stochastic bargaining models. *Econometrica*, *80*(4), 1563–1604.

Merlo, A. & Wilson, C. (1995). A stochastic model of sequential bargaining with complete information. *Econometrica: Journal of the Econometric Society*, 371–399.

Oxoby, R. J. & Spraggon, J. (2008). Mine and yours: Property rights in dictator games. *Journal of Economic Behavior & Organization*, *65*(3), 703–713.

Pitchford, R. & Wright, M. L. (2012). Holdouts in sovereign debt restructuring: A theory of negotiation in a weak contractual environment. *The Review of Economic Studies*, *79*(2), 812–837.

Rubinstein, A. (1982). Perfect equilibrium in a bargaining model. *Econometrica: Journal of the Econometric Society*, 97–109.

Sandberg, S. (2013). *Lean in: Women, work, and the will to lead*. Random House.

Säve-Söderbergh, J. (2007). *Are women asking for low wages? gender differences in wage bargaining strategies and ensuing bargaining success*. Swedish Institute for Social Research.

Schubert, R., Brown, M., Gysler, M., & Brachinger, H. W. (1999). Financial decision-making: Are women really more risk-averse? *The American economic review*, *89*(2), 381–385.

Simcoe, T. (2012). Standard setting committees: Consensus governance for shared technology platforms. *The American Economic Review*, *102*(1), 305–336.

Small, D. A., Gelfand, M., Babcock, L., & Gettman, H. (2007). Who goes to the bargaining table? the influence of gender and framing on the initiation of negotiation. *Journal of personality and social psychology*, *93*(4), 600.

Solnick, S. J. (2001). Gender differences in the ultimatum game. *Economic Inquiry*, *39*(2), 189.

Tergiman, C. (2015). Institution design and public good provision: An experimental study of the vote of confidence procedure. *Experimental Economics*, *18*(4), 697–717.

Thaler, R. H. & Johnson, E. J. (1990). Gambling with the house money and trying to break even: The effects of prior outcomes on risky choice. *Management science*, *36*(6), 643–660.

Appendix A. Alternative Allocation Proposals in Two Treatments

Table 9: Alternative Allocation Proposals in Two Treatments for Game 1 and Game 2

	Game 1 (IAe)								
	Stage 1								
#	1	2	3	4	5	6	7	8	9
G	(+0,+900)	(+100,+850)	(+380,+710)	(+570,+615)	(+600,+600)	(+615,+570)	(+710,+380)	(+850,+100)	(+900,+0)
L	(-1080,-180)	(-980,-230)	(-700,-370)	(-510,-465)	(-480,-480)	(-465,-510)	(-370,-700)	(-230,-980)	(-180,-1080)
	Stage 2								
#	1	2	3	4	5	6	7	8	9
G	(+0,+720)	(+80,+680)	(+260,+590)	(+380,+530)	(+480,+480)	(+530,+380)	(+590,+260)	(+680,+80)	(+720,+0)
L	(-1080,-360)	(-1000,-400)	(-820,-490)	(-700,-550)	(-600,-600)	(-550,-700)	(-490,-820)	(-400,-1000)	(-360,-1080)
	Game 2 (IAi)								
	Stage 1								
#	1	2	3	4	5	6	7	8	9
G	(+0,+900)	(+100,+850)	(+380,+710)	(+570,+615)	(+600,+600)	(+615,+570)	(+710,+380)	(+850,+100)	(+900,+0)
L	(-1080,-180)	(-980,-230)	(-700,-370)	(-510,-465)	(-480,-480)	(-465,-510)	(-370,-700)	(-230,-980)	(-180,-1080)
	Stage 2								
#	1	2	3	4	5	6	7	8	9
G	(+0,+1080)	(+120,+1020)	(+380,+890)	(+580,+790)	(+720,+720)	(+790,+580)	(+890,+380)	(+1020,+120)	(+1080,+0)
L	(-1080,-0)	(-960,-60)	(-700,-190)	(-500,-290)	(-360,-360)	(-290,-500)	(-190,-700)	(-60,-960)	(-0,-1080)

Table 10: Alternative Allocation Proposals in Two Treatments for Game 3 and Game 4

	Game 3 (DAe)								
	Stage 1								
#	1	2	3	4	5	6	7	8	9
G	(+0,+900)	(+80,+740)	(+210,+480)	(+270,+360)	(+300,+300)	(+360,+270)	(+480,+210)	(+740,+80)	(+900,+0)
L	(-1080,-180)	(-1000,-340)	(-870,-600)	(-810,-720)	(-780,-780)	(-720,-810)	(-600,-870)	(-340,-1000)	(-180,-1080)
	Stage 2								
#	1	2	3	4	5	6	7	8	9
G	(+0,+1080)	(+100,+880)	(+250,+580)	(+320,+440)	(+360,+360)	(+440,+320)	(+580,+250)	(+880,+100)	(+1080,+0)
L	(-1080,-0)	(-980,-200)	(-830,-500)	(-760,-640)	(-720,-720)	(-640,-760)	(-500,-830)	(-200,-980)	(-0,-1080)
	Game 4 (DAi)								
	Stage 1								
#	1	2	3	4	5	6	7	8	9
G	(+0,+900)	(+80,+740)	(+210,+480)	(+270,+360)	(+300,+300)	(+360,+270)	(+480,+210)	(+740,+80)	(+900,+0)
L	(-1080,-180)	(-1000,-340)	(-870,-600)	(-810,-720)	(-780,-780)	(-720,-810)	(-600,-870)	(-340,-1000)	(-180,-1080)
	Stage 2								
#	1	2	3	4	5	6	7	8	9
G	(+0,+720)	(+70,+580)	(+170,+380)	(+210,+300)	(+240,+240)	(+300,+210)	(+380,+170)	(+580,+70)	(+720,+0)
L	(-1080,-360)	(-1010,-500)	(-910,-700)	(-870,-780)	(-840,-840)	(-780,-870)	(-700,-910)	(-500,-1010)	(-360,-1080)

* Notes for Table 9 and Table 10: (a, b) denotes an allocation, where a is the payoff to self, and b is the payoff to counterpart. Payoffs are all in experimental dollars (E$). "G" stands for the Gain treatment, and "L" stands for the Loss treatment. Since subjects earn an endowment of 1080 in the Loss treatment, net profits under each alternative are the same between treatments.

Appendix B. Lottery Measure of Risk Attitudes in Gain and Loss Domains

Table 11: Risk Preferences in Gain Domain Based on MPL Choices

Risk Aversion	Lottery	Sure Amount	Range of CRRA coefficient r for $u(x) = \frac{x^{1-r}}{1-r}$	Risk Preference Classification
0	50% of 150, 50% of 0	-	$r < -2.80$	Risk loving
1	50% of 150, 50% of 0	125	$-2.80 < r < -0.71$	
2	50% of 150, 50% of 0	100	$-0.71 < r < 0$	Risk neutral
3	50% of 150, 50% of 0	75	$0 < r < 0.37$	
4	50% of 150, 50% of 0	50	$0.37 < r < 0.61$	Risk averse
5	50% of 150, 50% of 0	25	$r > 0.61$	

Table 12: Risk Preferences in Loss Domain Based on MPL Choices

Risk Aversion	Lottery	Sure Amount	Range of CRRA coefficient r for $u(x) = \frac{x^{1-r}}{1-r}$	Risk Preference Classification
0	50% of -150, 50% of 0	-	$r < -2.80$	Risk loving
1	50% of -150, 50% of 0	-25	$-2.80 < r < -0.71$	
2	50% of -150, 50% of 0	-50	$-0.71 < r < 0$	Risk neutral
3	50% of -150, 50% of 0	-75	$0 < r < 0.37$	
4	50% of -150, 50% of 0	-100	$0.37 < r < 0.61$	Risk averse
5	50% of -150, 50% of 0	-125	$r > 0.61$	

* Notes for Table 11 and Table 12: *Risk Aversion* equals the number of sure amount choices out of the five questions. In both domains, individuals start from choosing "sure amount" and switch to "lottery" at some point, and are allowed to switch for only once. Individuals with a value of 0 always choose the lottery. Individuals with a value of 5 always choose the sure amount. A bigger value means more risk averse. All numbers in lottery and sure amount choices are in E$.

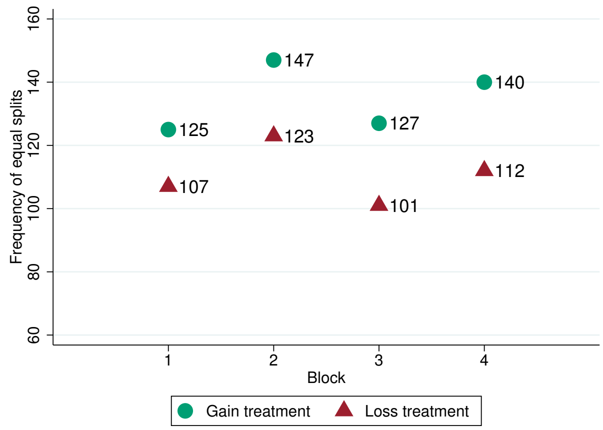
Appendix C. Gender Differences in Responder Behavior

Table 13: Treatment Effects and Gender Differences in Responder Behavior

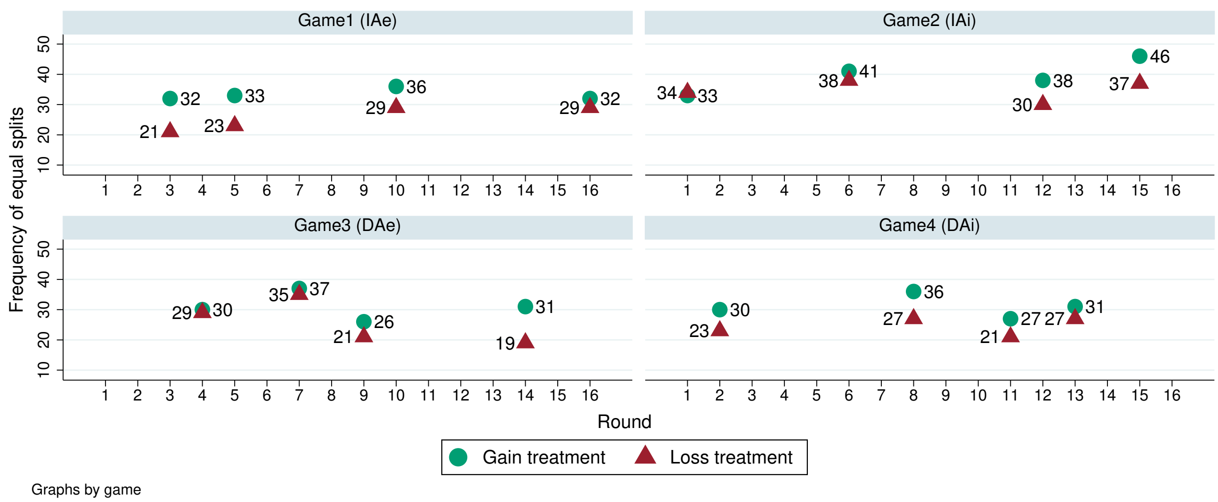
	Dependent variable: Accept			
Sample:	All		Gain treatment	Loss treatment
	(1)	(2)	(3)	(4)
Female	0.0152	0.0163	-0.0147	0.0413
	(0.0214)	(0.0215)	(0.0331)	(0.0281)
Loss treatment		0.0144	-	-
		(0.0213)		
Proposal=5 as base group				
Proposal=3	-0.123	-0.124	-0.387	0.121***
	(0.218)	(0.216)	(0.358)	(0.0255)
Proposal=4	0.0464	0.0453	0.120***	-0.0188
	(0.0725)	(0.0729)	(0.0194)	(0.128)
Proposal=6	-0.271***	-0.272***	-0.278***	-0.266***
	(0.0259)	(0.0262)	(0.0413)	(0.0327)
Proposal=7	-0.570***	-0.572***	-0.596***	-0.560***
	(0.0326)	(0.0331)	(0.0540)	(0.0416)
Proposal=8	-0.765***	-0.766***	-0.776***	-0.762***
	(0.0387)	(0.0387)	(0.0494)	(0.0578)
Proposal=9	-0.878***	-0.877***	-0.878***	-0.875***
	(0.0128)	(0.0129)	(0.0170)	(0.0195)
Constant	0.870***	0.862***	0.887***	0.858***
	(0.0193)	(0.0221)	(0.0310)	(0.0247)
No. of observations	2106	2106	1024	1082
R^2	0.254	0.255	0.266	0.245

[*] Notes: OLS regression with clustering at the individual subject level. Robust standard errors in parentheses. Significant levels are indicated by $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$. Dependent variable *Accept* = 1 if the responder accepts the proposal from his/her proposer; = 0 if the responder rejects the proposal. Independent variables *Female*, equal to 1 if the responder is a female and 0 otherwise; *Loss treatment* equals 1 if in the Loss treatment and 0 in the Gain treatment. Proposal dummies as control variables: proposal=5 (equal split) serves as the base group. The cases where proposers choose "pass" are excluded.

Appendix D. Dynamics of Equal Splits



(a) Frequency of Equal Splits by Block



(b) Frequency of Equal Splits by Rounds

Figure 6: Dynamics of Equal Splits. Notes: Each four consecutive rounds form a block. Each block contains a different order of the four games.

Table 14: Dynamics of Equal Splits

Dependent variable:	FracEqualSplit				FreqEqualSplit			
Sample:	All bargaining rounds							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Block	0.0145	0.0145			0.225	0.225		
	(0.0177)	(0.0117)			(1.014)	(0.689)		
Round			0.00423	0.00423			0.110	0.110
			(0.00428)	(0.00280)			(0.245)	(0.166)
Loss treatment		-0.118***		-0.118***		-6.000***		-6.000***
		(0.0261)		(0.0258)		(1.541)		(1.532)
Game dummies	no	yes	no	yes	no	yes	no	yes
Constant	0.437***	0.557***	0.438***	0.557***	30.13***	31.81***	29.75***	31.44***
	(0.0486)	(0.0413)	(0.0414)	(0.0374)	(2.778)	(2.437)	(2.373)	(2.220)
No. of observations	32	32	32	32	32	32	32	32
R^2	0.022	0.632	0.032	0.642	0.002	0.600	0.007	0.605

* Notes: OLS regression. Standard errors in parentheses. Significant levels are indicated by $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$. For model (1)-(4), dependent variable *FracEqualSplit* is the fraction of equal splits out of the total nonpass proposals made, calculated by treatment and round. For model (5)-(8), dependent variable *FreqEqualSplit* is the number of equal splits, counted over treatment and round. Independent variables *Block* is an integer number from 1 to 4, and *Round* is an integer number from 1 to 16. For each session, there are 16 rounds in total, and each four consecutive rounds form a block. Each block contains a different order of the four games. Control variables include *Loss treatment*, equal to 1 if in the Loss treatment and 0 in the Gain treatment and game dummies.

Appendix E. Gender differences in Equal Splits for Each Game

Table 15: Treatment Effects and Gender Differences on Equal Splits for Each Game

	Dependent variable: EqualSplit							
Sample:	Game1(IAe)		Game2(IAi)		Game3(DAe)		Game4(DAi)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Loss	-0.188***	-0.271***	-0.0775	-0.154	-0.112*	-0.202**	-0.129**	-0.187**
	(0.0682)	(0.0976)	(0.0642)	(0.0953)	(0.0594)	(0.0825)	(0.0604)	(0.0861)
Female	0.160**	0.0705	0.0594	-0.0121	0.106*	0.0185	0.152**	0.0974
	(0.0678)	(0.102)	(0.0646)	(0.0907)	(0.0590)	(0.0891)	(0.0603)	(0.0879)
Loss × Female		0.172		0.143		0.169		0.107
		(0.136)		(0.128)		(0.117)		(0.120)
Constant	0.547***	0.585***	0.538***	0.575***	0.385***	0.428***	0.426***	0.454***
	(0.0631)	(0.0750)	(0.0574)	(0.0675)	(0.0536)	(0.0635)	(0.0553)	(0.0658)
No. of observations	446	446	560	560	596	596	504	504
R^2	0.055	0.062	0.009	0.014	0.023	0.031	0.039	0.042

* Notes: OLS regression with clustering at the individual subject level. Robust standard errors in parentheses. Significant levels are indicated by $^{*}p < 0.1,^{**} p < 0.05,^{***} p < 0.01$. Dependent variable *EqualSplit* = 1 if the proposal chosen gives equal payoff to both players; = 0 otherwise.Independent variables *Loss* equals 1 if in the Loss treatment and 0 in the Gain treatment; *Female*, equal to 1 if the proposer is a female and 0 otherwise. Proposers' choices of "pass" are excluded.