University of Innsbruck

Fair division in unanimity bargaining with subjective claims

Anita Gantner, Kristian Horn,
Rudolf Kerschbamer

Working Papers in Economics and Statistics

2013-31

Research Platform
eeecon
Empirical and Experimental Economics
University of Innsbruck
http://eeecon.uibk.ac.at/

University of Innsbruck
Working Papers in Economics and Statistics

The series is jointly edited and published by

- Department of Economics
- Department of Public Finance
- Department of Statistics

Contact Address:
University of Innsbruck
Department of Public Finance
Universitaetsstrasse 15
A-6020 Innsbruck
Austria
Tel: + 43 512 507 7171
Fax: + 43 512 507 2970
E-mail: eeecon@uibk.ac.at

The most recent version of all working papers can be downloaded at
http://eeecon.uibk.ac.at/wopec/

For a list of recent papers see the backpages of this paper.

Fair Division in Unanimity Bargaining with Subjective Claims*

Anita Gantner, Kristian Horn and Rudolf Kerschbamer
Department of Economics, University of Innsbruck

October 2013

Abstract

In an experiment on a subjective claims problem we compare three unanimity bargaining procedures – the *Demand*, the *Offer* and the *Exit* variant – in terms of fairness and efficiency. To assess the fairness of the allocations obtained by these procedures, we evaluate them from a partial point of view using stakeholders' subjective evaluations of claims as elicited in a hypothetical fairness question, and we evaluate them from an impartial point of view using spectators' responses in a vignette. We find that after correcting for the self-serving bias in the partial view, both views point towards the same allocation. The *Offer* variant, which requires stakeholders to supply complete division proposals, yields outcomes that come closest to this fair allocation.

Keywords: Fair Division, Subjective Claims, Bargaining, Experiment

JEL Classification: D63, C91, D61

*Corresponding author: Anita Gantner, Department of Economics, University of Innsbruck, Universitätsstr. 15, 6020 Innsbruck, Austria; anita.gantner@uibk.ac.at. We thank Alexander Cappelen, Michael Pfaffermayr, Erik Sorensen and Bertil Tungodden for their valuable comments. This project was supported by funds of the Oesterreichische Nationalbank (Anniversary Fund, project number: 13595).

1 Introduction

When married couples are asked separately which fraction of various household tasks they are responsible for, the reported fractions add up to more than 100% (Ross and Sicoly 1982). It is then not surprising when out-of-court settlements in case of divorce are difficult to achieve. While this is arguably in part due to the fact that a fair outcome is not always the prevalent goal in divorce settlements, even fair-minded parties might fail to achieve agreements due to the well-established fact that fairness judgements are biased in a self-serving way.[1] This bias persists even if involved parties explicitly try to take the viewpoint of another party, such as that of a judge in a legal dispute, and it negatively affects the ability to reach voluntary settlements.[2] In other words, out-of-court settlements in case of divorce may fail not only because parties behave strategically in their pursuit of maximizing own material payoffs, but also because fairness judgements are biased by self-interest. As economists, we want to find a procedure that provides a solution for this kind of settlement problem – a solution the involved parties are content with. A well-designed bargaining protocol might be such a procedure.

The stimulus for the present study came from another example where material self-interest and biased fairness judgments of involved parties are likely to hamper a consensual solution: In Tyrol, Austria, a company plans to build a new water power plant in a location that has common borders with three municipalities. The company paid a certain amount of money to the municipalities in exchange for the right to use land and water. The municipalities accepted the joint compensation in the negotiations with the company without having established an agreement on the division of this amount amongst themselves. The obvious question is now what would be the fair share for each of them, given that they give up different things in exchange – one owns land and water rights, another contributes only water rights, a third only land. There is no objective or straightforward way to

[1]See e.g. Messick and Sentis (1979 and 1983), Kagel et al. (1996), or Konow (2000) for empirical evidence on self-serving biases in fairness judgements.

[2]Loewenstein et al. (1993) report that subjects who were in the role of plaintiff and defendant in an experimental legal dispute and who had to give an assessment of a fair award for the plaintiff as well as a prediction of an actual judge's award were extremely biased in both assessments. Babcock et al. (1995) find no empirical support for the presumption that shared information among the involved parties would lead to convergence of expectations regarding the verdict and would thus facilitate out-of-court settlement.

divide the amount awarded, since contributions cannot be easily compared. Also, estimating the value of a given municipality's contribution by removing it from the partnership is of limited help, since the individual market values of the water and land rights are fairly small compared to the combined value of the resources. Asking an impartial outside observer to assign shares to the involved partners may be a solution, but an outsider typically has far less information on the contributions and the fairness judgments of the partners than the partners themselves, and because eliciting truthful information from the partners is likely to be a non-trivial task. The partners may therefore prefer to rely on their own subjective perceptions on how the amount should be divided fairly. Bargaining is then a natural way to have parties resolve their dispute regarding the division of the amount.

In this study, we investigate in a large experiment with more than 600 participants the fairness and efficiency of three unanimity bargaining protocols used to reach a consensus in a *subjective claims problem*. Such a problem arises when a given amount of money (the 'cake') is to be divided amongst a given number of agents (the 'partners'), who hold entitlements to it. Entitlements (or 'claims') are subjective and have been derived from inputs that are not directly comparable. Thus, subjective assessments of claims are likely to be conflicting. Throughout, we assume that the partners are interested not only in their own material payoff, but also in the fairness of the allocation. We will refer to a division of the cake that is considered fair by partner i as i's *subjective evaluation of claims*. Denoting the cake size by S and considering a division problem involving n partners such a subjective evaluation of claims is a vector with n entries summing up to S. The subjective claims problem is then to find an allocation $s = (s_1, \dots s_n)$, where $\sum_i s_i \leq S$, or alternatively, a procedure that implements such an allocation, which is considered fair by the partners (in the sense that it respects the partners' subjective evaluations of claims in some appropriate sense – see the discussion below) and which is also efficient (in the sense that $S - \sum_i s_i$ is minimized).[3]

We generate a subjective claims problem involving three partners in the experi-

[3]While the subjective claims problem refers to n privately known vectors of claims (one vector for each of the n agents), where vector i describes agent i's perception of how the available amount should be divided, the objective claims (or bankruptcy) problem refers to one publicly known vector of n objective claims (one claim for each of the n agents) which add up to more than the available amount. See Moulin (2002) and Thomson (2003) for surveys on the objective claims problem.

mental lab. This is done by having subjects perform real effort tasks and assigning them points depending on their relative performance in their cohorts. Partnerships consisting of subjects coming from different cohorts are then formed and the points a subject has earned in the real effort task is the contribution of this subject towards the partnership. Subjects do not know the amount of effort their partners exert, nor do they know their performance in the real effort task; they are only informed about partners' respective contributions in points. All contributions enter a non-linear production function determining the size of the jointly produced cake. We then elicit the possibly conflicting subjective evaluations of claims of the partners in a hypothetical fairness question before we let the partners actually produce a division of the cake by means of one of the following three unanimous bargaining procedures:

- In the **Demand** variant introduced by Torstensson (2009) players take turns in making proposals regarding their own share of the cake, and an agreement is achieved if the proposals of the partners add up to no more than the cake size.
- In the **Offer** variant due to Shaked (see Sutton 1986) players take turns in making complete division proposals, and an agreement is achieved if all partners agree on a proposal.
- In the **Exit** variant studied by Krishna and Serrano (1996) players take turns in making complete division proposals, and any player who accepts the share assigned to him by the current proposer may exit, while the proposer continues to bargain with the partner who has not accepted his proposed share.

Evaluating the fairness of an allocation is not trivial in the subjective claims problem. While there is strong evidence that objective fairness norms – such as proportionality – play an important role for the evaluation of claims in division problems where entitlements are objective and common knowledge (see e.g. Gächter and Riedl 2006, or Herrero et al. 2010), the subjective claims problem makes it difficult to apply such a norm. The reason is that contributions (household tasks in the married couples example; land and water rights in the power plant example;

performance ranks in different cohorts in the real effort task in the experiment) are difficult to compare by the involved parties, and unobservable to outsiders. Thus, for an outside observer, who may be asked - as impartial arbitrator - to assign fair shares to the partners, there exists no sound basis upon which he could apply any fairness standard based on inputs. For stakeholders, who could in principle apply such a standard, a prediction regarding the relevance of different standards for subjective evaluations of claims is difficult to obtain. On the one hand, the literature on moral wiggle room (e.g. Dana et al. 2005) suggests that subjects tend to appeal to the standard that yields the highest payoff for them, when multiple fairness standards can plausibly be applied; this arguably is the case in a subjective claims problem, where contributions are difficult to compare. On the other hand, numerous studies have documented the existence of a self-serving bias in fairness assessments when stakes are involved (see, e.g., Babcock et al. 1996, Kagel et el. 1996, or Konow 2000). This latter bias could lead to fairness assessments that do not correspond to any of the standards discussed in the literature. To receive information on the relevance of different fairness standards for our subjective claims problem and to assess the fairness of bargaining outcomes we combine different pieces of information.

First, we use the elicited subjective evaluations of claims from the fairness question as a benchmark. We ask whether those answers are shaped by prominent fairness standards (such as proportionality) and we compare them to actual bargaining outcomes. Clearly, this latter comparison is an evaluation from a partial point of view, but we consider the stakeholders view important here, since, after all, it is the involved parties who have to live with the final outcomes, and they have more information than anyone else on partners contributions. A second yardstick regarding the fairness of bargaining outcomes is derived from the vignettes technique, which uses questions in a survey describing concrete but hypothetical scenarios in order to elicit fairness views (see e.g. Konow 2003, or Yaari and Bar-Hillel 1984). In our context, impartial outside observers are asked what they consider a fair division of the cake - having the same information as the partners in the experiment - and their fairness assessments are then compared to the actual bargaining outcomes. The impartial point of view expressed in the vignette shall also help us put into perspective the self-serving bias which is expected in stakeholders responses to the fairness question. Finally, we test whether there is evidence for well-known fairness standards in actual bargaining outcomes.

Our results show that subjects do derive different subjective claims from the real effort tasks, which they try to implement in the bargaining outcomes, and these claims take into consideration partners' relative contributions towards the jointly produced cake. This suggests that despite different subjective evaluations of claims, subjects overall do show a desire to reward individual contributions, even though the latter are difficult to compare. This stands in contrast to the standard prediction for the bargaining procedures, which relies on the assumption that players are rational and only interested in their own material payoff (and that this is common knowledge) and thereby treats the cake as "manna from heaven". Under this assumption players' impatience (as expressed in their discount factor), their outside option (which is assumed to be zero for all players in our context), and their strategic position in the game determines the bargaining outcome. We find that under all bargaining procedures agents with a higher contribution tend to receive a payoff higher than the equal split, but lower than the share predicted by the proportional standard applied to contributions, while agents with a lower contribution generally receive a payoff lower than the equal split but higher than the share predicted by the proportional standard. This tendency is consistent with the results from the fairness question, where responders are stakeholders, as well as the results from the vignette, where responders are impartial outside observers. Interestingly, those two views point to very similar allocations after correcting for the self-serving bias in the fairness judgements of stakeholders. This is an important insight in itself, since it implies that impartial fairness evaluations can be derived from stakeholders' responses to the fairness question.

While the tendency to reward contributions (albeit less than proportionally) is present in the outcomes of all bargaining protocols we tested, realized payoffs depend on the strategic position of a player in the bargaining procedure: In the *Exit* variant, players who are able to exit are better off, which implies a disadvantage for first movers, contrary to the standard prediction which would imply a first mover advantage. In the *Demand* variant, players in the position of the last mover suffer from high demands of the other players. This does not happen in the *Offer* variant, where the first mover has to make a complete division proposal. In other words, in the *Demand* and in the *Exit* variant of unanimity bargaining the strategic position of a player determines to what extent an (ex ante posited) fair division can actually be achieved. For instance, while in their responses to the fairness question most subjects respect the notion that equal contributions should result in equal shares of the cake, the realized payoffs in the *Exit* variant do not reflect this fairness notion. Overall, we find that the *Offer* variant performs best in terms of preserving the fairness ideas reflected in the partial and impartial views, while there is not much difference across procedures in terms of efficiency.

The rest of the paper is organized as follows: Section 2 discusses the related literature. Section 3 describes the three bargaining procedures and Section 4 the design of the experiment and the vignettes study. Section 5 discusses the normative fairness standards we consider. In section 6, the results of the vignette and the fairness question as well as the outcomes of the bargaining procedures are presented, and the latter are assessed in terms of fairness from a partial and impartial point of view. Section 7 concludes.

2 Related Literature

By now, a large body of evidence questions the assumption of purely selfish behavior of economic agents and suggests that fairness considerations indeed influence bargaining behavior in various games (see Camerer 2003 for a review). In the absence of production, the equal split seems to be a commonly accepted division rule, or norm of distributive justice, which was also confirmed in a theoretical analysis of Ashlagi et al. (2012). In the last decade, however, several studies found that a joint production of the cake introduces norms of desert and equity that strongly influence behavior (see the survey by Karagözoglu 2012). This is especially true if production involves real effort which induces even stronger entitlements. Gächter and Riedl (2005, 2006) show how unequal claims derived from ordinal information about performance in paired subjects shapes negotiations in bilateral bargaining. Karagözoglu and Riedl (2010) find that with competitive tasks leading to joint production, the division is away from the equal split only when paired subjects have information about their relative performance.

There are basically two approaches to get a notion of what agents consider fair in division problems with production. On the one hand, following a large empirical literature on the relevance of different norms of justice (see Konow 2003 for a review), Gächter and Riedl (2006) use the vignettes technique. Here, impartial survey participants answer hypothetical fairness questions on what a fair division would be from the point of view of a neutral outsider. On the other hand, many studies take a partial view and have subjects play bargaining or dictator games, whose outcomes are then compared to prominent norms of distributive justice, such as the equal or the proportional split (e.g. Konow 2000, Gantner et al. 2001, Fischbacher et al. 2009). Gächter and Riedl (2006) compare the two approaches in an objective claims problems and find that while the "constrained equal awards" rule comes closest to the actual bargaining payoffs, the proportional split is the most attractive normative concept from the impartial viewpoint.

In a context of observable effort levels, Cappelen et al. (2007) refer to the three most important norms underlying distributive justice as egalitarianism (equalizing all inequalities), libertarianism (following the proportionality principle), and liberal egalitarianism (equalizing inequalities if they are not under individual control). Analyzing the outcomes of dictator games, they find evidence consistent with a pluralism of justice norms in their data, with the liberal egalitarian division to be most prevalent. While Rodriguez-Lara and Moreno-Garrido (2012) in a recent contribution with real effort production confirm the multiplicity of fairness rules, they find that these are context dependent and applied so as to benefit the proposer. Specifically, their findings suggest that the proportionality rule is employed when the proposer happens to have a high input, while it is rejected in favour of the more egalitarian split if he only has a low input. This 'exploitation of moral wiggle room' (Dana et al. 2005) is then also expected to play a role when claims are subjective. The experimental study by Fischbacher et al. (2009) addresses this question by having two partners contribute towards joint output, where non-additive marginal productivities are also considered.[4] They find evidence for a "performance-based fairness idea", i.e. in case of unequal performance in real effort the high-performance subject receives a larger share, however, shares are independent of marginal productivities. Interestingly, they find no difference in division allocations that are determined by an ultimatum game compared to those

[4]Note that in Fischbacher et al. (2009) the division rule is fixed before the cake is produced, while in our experiment it is vice versa.

imposed by an impartial third party, implying that relative bargaining power of stakeholders does not play a role. This stands in contrast to the results of Konow et al. (2009), who found that impartial observers tend to refer to the proportional standard while equality is more often observed amongst stakeholders, and this effect is stronger as anonymity among stakeholders is removed. Our direct comparison of three unanimity bargaining procedures yields a more differentiated result: We find that in unanimity bargaining the strategic position, i.e. bargaining power, has an impact on outcomes and thus on the implementation of fairness standards, including those impartial observers refer to.

Our study contributes to the existing literature in various respects. First and foremost, in contrast to the studies cited here, we are not only interested in what people consider a fair division, but we also compare different bargaining procedures to understand which features of a procedure may be important to achieve fair outcomes when claims are subjective. Second, in contrast to most studies (e.g. Gächter and Riedl 2005 and 2006; Cappelen et al. 2007), we study subjective claims over a joint production, as we believe that imperfect information on efforts, non-comparability of contributions and nonlinear production are important characteristics of bargaining situations outside the lab. Third, compared to other papers studying environments with asymmetric claims where agents merely have ordinal information about the partner's performance (e.g. Karagözoglu and Riedl 2010, Fischbacher 2009), our setting is richer (by having three players, different cake sizes and different contribution types) and thereby allows us to examine a richer set of fairness norms, and the extent to which subjects endorse them. We evaluate the bargaining outcomes in terms of fairness by comparing them to prominent fairness norms (as in Cappelen et al. 2007), to judgments from a hypothetical fairness question *within* the context of the experiment (as in Gächter and Riedl 2005), and also to the impartial judgments obtained by the vignettes technique (as in Gächter and Riedl 2006). Finally, we experimentally examine fair division in multilateral infinite horizon unanimity bargaining. This is important, since the scenario we describe is not confined to two agents, and since it is not straightforward to extend two-person bargaining results to an environment with three or more participants. For instance, when only two players are involved, it is clear that both have to agree on the division of the cake. With three or more players, one has to decide whether to follow a majoritarian or a unanimity decision rule. Also, when only two players are involved, there is no difference between an offer and a demand variant of bargaining. With three or more players one has to decide between a demand and an offer protocol, and for each protocol there are many possibilities how this translates to a concrete procedure. Our focus will be on unanimity bargaining procedures since it is in the nature of the problem that the parties involved, i.e. the stakeholders, should be satisfied with the outcome.[5] Specifically, we will test three different unanimity bargaining procedures here – the *Offer* variant proposed by Shaked (as reported by Sutton 1986), the *Demand* variant by Torstensson (2009), and the *Exit* variant by Krishna and Serrano (1996) – none of which has, to our knowledge, been tested experimentally before.

3 Bargaining Environment and the Three Procedures

Consider a subjective claims problem where the three partners A, B, and C have jointly produced the cake S, which has now to be divided amongst them. We assume that each partner is interested not only in her own payoff or share of S, but also in the fairness of the allocation. Denote agent i's subjective evaluation of claims by $c^i = (c^i_A, c^i_B, c^i_C)$, where c^i_j stands for the amount partner j should receive from agent i's perspective. Throughout we assume that $c^i_A + c^i_B + c^i_C = S$ for $i = A, B, C$. Each of the three bargaining procedures we consider yields an allocation $s = (s_A, s_B, s_C)$, where $\sum_i s_i \leq S$, which we will evaluate in terms of efficiency (in the sense that $S - \sum_i s_i$ is minimized) and in terms of how well it represents the subjective evaluations of claims of the three agents, the impartial view of spectators and some well-known fairness standards from the literature. The following three unanimity bargaining procedures will be compared:

[5] Majoritarian decision rules received high attention in political bargaining and voting models – see the theoretical models by Baron and Ferejohn (1987 and 1989), and Morelli (1999), as well as the corresponding experimental literature by Frechette, Kagel, Lehrer (2003), Frechette, Kagel, Morelli (2005a and 2005b), Diermeier and Morton (2004), Diermeier and Gailmard (2006). Miller and Vanberg study costly delay in multilateral bargaining comparing majority and unanimity rule. Majoritarian ultimatum bargaining with three players in different bargaining procedures was analyzed by Güth et al. (1996) and Güth and van Damme (1998).

3.1 Torstensson's *Demand* Variant

In the *Demand* variant introduced by Torstensson (2009), players take turns in making demands, that is, proposals regarding their own share. In round $t = 1$ players 1 and 2 make successive demands x_1 and x_2. If these demands are compatible ($x_1 + x_2 \leq S$) and the third player accepts, the game ends with an agreement in which players 1 and 2 receive x_1 and x_2, respectively, while player 3 gets $x_3 = S - x_1 - x_2$. If the demands of players 1 and 2 are not compatible, or if the third player rejects, bargaining proceeds to round $t = 2$, this time the original player 2 in the role of player 1, 3 in the role of player 2 and 1 in the role of player 3. The rules for an agreement correspond to those described for $t = 1$ and in case of disagreement the game proceeds to the next round. There is no exogenous termination round (i.e. no limit for the time horizon of the bargaining game), and in case of agreement, payoffs are discounted by the common discount factor $\delta < 1$; that is, if an agreement is reached in round t where player i receives x_i, then i's actual payoff is $\delta^{t-1}x_i$. The theoretical prediction for this procedure depends on the exact shape of agents' preferences and their information about the partners' preferences, of course. In order to keep things tractable, we refer here and in the following only to the theoretical benchmark for the case where it is common knowledge that all players are exclusively interested in their own monetary payoff.[6] Under this assumption most agreements can be supported as subgame perfect equilibrium (SPE) outcomes by specified state-dependent strategies. More precisely, for $\delta > \frac{1}{2}$, every allocation of the dollar where $s_3 \leq \delta S$ can be supported in a SPE (Torstensson 2009). There is a unique stationary ("history free") SPE, which involves no delay and leads to the allocation $s = (S/(1+\delta+\delta^2), \delta S/(1+\delta+\delta^2), \delta^2 S/(1+\delta+\delta^2))$, i.e., there is a clear first mover advantage in the stationary SPE.

3.2 Shaked's *Offer* Variant

In the *Offer* variant due to Shaked (as reported by Sutton 1986), players take turns in making complete division proposals $x = (x_1, x_2, x_3)$, where x_i is the share

[6] The selfish benchmark is mentioned for the sake of completeness since the assumption of agents' purely selfish behavior is not satisfied if fairness norms play a role (which is what we assume).

proposed for player i and where $\sum_i x_i = S$. Player 1 makes the first proposal in round $t = 1$. Player 2 and player 3 then respond sequentially, each either accepting or rejecting the proposal. If both responders accept, then the game ends with player i getting a payoff of x_i. In case of a rejection, the game proceeds to round $t = 2$, where player 2 makes a proposal and players 3 and 1 sequentially respond. If one of the latter two players rejects, then the next round begins with player 3 making an offer, and so on. Again, there is no exogenous termination round, and payoffs are discounted by the common discount factor δ. Shaked (reported by Sutton 1986) showed that under standard assumptions every allocation of the dollar can be supported as a SPE for $\delta > \frac{1}{2}$. Again, there is a unique stationary SPE, which involves no delay and leads to the allocation $s = (S/(1+\delta+\delta^2), \delta S/(1+\delta+\delta^2), \delta^2 S/(1+\delta+\delta^2))$, thus again, there is a first mover advantage in the unique stationary SPE.[7]

3.3 Krishna and Serrano's *Exit* Variant

In the *Exit* variant introduced by Krishna and Serrano (1996), players take turns in making complete division proposals, just as in Shaked's offer variant. Again, player 1 makes the first offer in round $t = 1$, and player 2 and player 3 respond sequentially. Again, if both accept, then the game ends and if both reject the game proceeds to the second round, where it is player 2's turn to make an offer. The only difference occurs if only one of the responders agrees. In this case she exits with the payoff she has accepted. The responder who disagrees remains in the game with the proposer, and the game proceeds as a two-person alternating-offers bargaining game over the remainder of the cake. In sum, the only difference between Shaked's *Offer* variant and the current *Exit* variant is that a player satisfied with his or her share can "take the money and run". Krishna and Serrano (1996) showed that (again under standard assumptions) this procedure leads to a unique SPE. It involves no delay and leads to the allocation $s = (S/(1+\delta+\delta), \delta S/(1+\delta+\delta), \delta S/(1+\delta+\delta))$. Again, there is a first mover advantage in this solution.

[7]See Herrero (1985). She also demonstrates that the stationary SPE is the unique strong SPE.

4 Design of Experiment and Vignette

4.1 The Subjective Claims Problem

In the experiment and the vignette, we have subjective claims problems involving three partners who first have to provide an amount of money S based on a real effort task, before S is divided amongst the three of them. The size of S is determined by partners' individual performances in a general knowledge quiz. For this real effort task, subjects are randomly assigned to one of three cohorts, each consisting of 6 subjects, and they are informed that (i) each subject in a cohort will be exposed to the same set of questions; (ii) each subject in a cohort will receive points depending on her relative performance within her cohort (in terms of correctly answered quiz questions within a given time period), where the two high performers within a cohort are assigned 4 points, the two medium performers 3 points, and the two low performers 2 points; (iii) after the quiz each subject will be assigned to a group of three partners, each coming from a different cohort; (iv) the points a subject acquires in the quiz will be her contribution to the joint profit of the group which is determined by a specific non-linear function (known to subjects and displayed below); and (v) the joint profit of the group will later be distributed amongst group members by some procedure. After the real effort task, subjects are awarded their respective points depending upon their relative performance within the cohort. Then they are assigned to a group consisting of three partners labelled A, B, C. The cake size S to be distributed amongst the three partners is then determined as

$$S = 12 + \textit{(points A)} \cdot \textit{(points B)} \cdot \textit{(points C)}.$$

4.2 Lab Experiment

Participants. We had a total of 612 students of all majors at the University of Innsbruck participate in this experiment. Sessions lasted for about 1 hour, and average earnings were 13.30 Euro. The experiment was programmed and conducted with the software z-Tree (Fischbacher 2007).

Cake Production. After performing the real effort task as described above, subjects are informed about their own rank within their cohort and points they achieved. Then they are assigned to a group consisting of three partners labelled A, B, C, where each partner comes from a different cohort, and they are informed about the points (but not the rank or actual quiz performance) their partners bring into the partnership. By using a relative performance measure *within* cohorts, but selecting the three partners from *different* cohorts, we implement the idea of having contributions in different currencies, as there is no possibility for subjects to directly compare their own quiz performance to that of the partners. Also, giving subjects information about partners' contributions in points reflects the idea that insiders are better informed than any outsider who can observe only the cake size. The non-linear production function intentionally complicates matters further, because it makes it difficult to translate the points a subject brings to the partnership into her fair share of the resulting cake size. Groups in the experiment are composed such that we have a small cake size of $S = 24$ with two low and one medium contributor, a medium cake size of $S = 36$ where all partners make different contribution in points, and a large cake size of $S = 60$ with one medium and two high contributors.[8]

Fairness Question. After being informed about their partners' contributions in points and the resulting cake size, subjects are privately asked what they consider a fair division of the jointly produced cake. That is, each subject i is asked to report a vector of his subjective evaluation of claims, $m_i = (m_A^i, m_B^i, m_C^i)$, where the entries have to sum up to S, knowing that the answer to this question is irrelevant for her earnings in the experiment. The answers to the fairness question shall serve as a first benchmark for our comparison of the three bargaining procedures in terms of allocative fairness. We will refer to m_i^i as partner i's *fair share to self* and to $(m_j^i + m_k^i)/2$ (for $\{i, j, k\} = \{A, B, C\}$ as partner i's *fair share from others.*

Actual Division of the Cake. In each experimental session, subjects are exposed to exactly one bargaining procedure and each subject participated in only one session.[9] For the *Demand* and *Offer* variant, we have 22 observations per cake

[8]Note that partners who bring in the same contribution in points may have performed differently in terms of correctly answered questions.

[9]Besides bargaining, we also tested the performance of three static mechanisms for our subjective claims problem. In each experimental session, subjects were first successively exposed to each of the three static mechanisms, and finally to one of the three bargaining procedures described here, without having feedback regarding the outcome of any procedure. Obviously, the outcome of bargaining is known upon agreement, therefore bargaining had to be the last procedure, and subjects could only be exposed to one bargaining procedure in order to avoid

Initial Cake Size		Player (move order)	Contribution in Points	# Observations		
				Demand	*Offer*	*Exit*
		1	2 low			
Small	S=24	2	3 medium	22	22	24
		3	2 low			
		1	3 medium			
Medium	S=36	2	2 low	22	22	24
		3	4 high			
		1	4 high			
Large	S=60	2	4 high	22	22	24
		3	3 medium			

Table 1: Experimental Treatments

size, which together corresponds to 198 subjects per bargaining procedure (with 3 different cake sizes and 3 subjects per cake size). For the *Exit* variant we have 24 observations per cake size, i.e. 216 subjects participated here. Table 1 shows the details of the experimental design. The cake size is denoted in points, and for each point earned in the experiment subjects were paid 0.25 Euro. In each session, the bargaining procedure is first described in detail, then each subject is asked to submit a proposal, which would be used as the actual initial proposal in case the subject is selected as first mover in the bargaining order. For the *Offer* and *Exit* variant, this proposal entails a complete division vector, while the *Demand* variant only asks each subject for a proposal regarding the own payoff. After this, subjects are informed about their role in the procedure (i.e., whether they are player 1, 2 or 3 in the first round), and they go through the respective bargaining procedure until bargaining is completed. To have enough observations for statistical tests (recall that we have three different procedures, three different cake sizes within each procedure, at least two different contribution types for each cake size, and three different player roles within each procedure), we keep the matching between player role and contribution type fixed across bargaining procedures within cake sizes. Across cake sizes, our assignment has subjects with different contributions assigned to the roles of player 1, 2, and 3, thus we can observe how players with

that the outcome of a procedure affects subjects' behavior in other procedures. Since we had a large set of data, we decided to separate static and dynamic procedures and we report only the results of the bargaining procedures in this paper.

different contributions behave in the role of a first, second or last mover. The discount factor was $\delta = 0.9$ in all bargaining procedures.[10]

4.3 Vignette

Participants. We had a total of 70 participants in our vignette study. Since our aim here is to get information on the impartial view of spectators, subjects from the lab study were excluded from participation in the vignette.

Impartial Fairness Question. In the vignette, we inform participants about the details of the subjective claims problem as described in subsection 4.1. For each cake size and all combinations of the partners' contributions that were used in the lab experiment we asked vignette participants what they consider a fair division among the partners, knowing the points each partner contributed towards the cake size (but not knowing the number of correctly answered questions or the exact rank of the partner in his cohort).

5 Normative Fairness Standards

Since we conjecture that participants' answers to the vignette as well as subjects' answers to the fairness question and their actual behavior in the experiment are shaped by norms of distributive justice, or fairness standards, we will refer to three well-known division standards when interpreting fairness assessments and observed bargaining payoffs: The *egalitarian standard* suggests to equalize all payoffs regardless of an agent's contribution to the cake, while the *proportional standard* suggests a division strictly according to agents' inputs into the production function. The *liberal standard* discussed by Cappelen et al. (2007) is somewhere in between by respecting inequalities as far as they result from factors that are under individual control – as, for instance effort – but not for other factors that influence the size of the cake. Thus, this standard reflects the idea that an agent can only be held responsible for his choices, but not for other factors that determine the size of the cake.[11] In a strict interpretation, the application of the liberal standard to our

[10]We also tried out a discount factor of 0.8 in some separate sessions, but this did not affect behavior in any significant way.

[11]For experimental evidence indicating that subjects care about effort but not about luck see Hoffman and Spitzer (1985), Burrows and Loomes (1994), Schokkaert and Lagrou (1983).

context would require observability of efforts. Since efforts are not observable in a subjective claims problem, we apply this fairness norm to partners' contributions in points, which are only a noisy signal of efforts. Specifically, we refer to the *egalitarian standard* when S is distributed equally among the partners, to the *proportional standard* when shares of S are assigned proportionally to the points each partner has contributed, and to the *liberal standard* when each partner receives an equal share of the fixed part of the production function and the remainder of S is divided proportionally to the points contributed.

Cake Size	Small			Medium			Large		
Contribution	2	2	3	2	3	4	3	4	4
Egalitarian Standard									
Rd. 1	8	8	8	12	12	12	20	20	20
Rd. 2	7.2	7.2	7.2	10.8	10.8	10.8	18	18	18
Proportional Standard									
Rd. 1	6.86	6.86	10.28	8	12	16	16.36	21.82	21.82
Rd. 2	6.17	6.17	9.26	7.2	10.8	14.4	14.72	19.64	19.64
Liberal Standard									
Rd. 1	7.43	7.43	9.14	9.33	12	14.67	17.1	21.45	21.45
Rd. 2	6.69	6.69	8.22	8.4	10.8	13.2	15.38	19.31	19.31

Table 2: Point Predictions of Fairness Standards

Table 2 displays the point predictions of the three fairness norms for each contribution type and cake size. The first row in each block specifies the division predicted by the considered standard when applied to the original cake size. This row is potentially relevant for fairness assessments from the partial and the impartial view, and for the bargaining outcome if an agreement is reached in the first round. The divisions specified in the second row are the point predictions of the respective fairness norm in case the bargaining outcome is reached in round 2, where discounting has reduced the available cake size. As the section on bargaining results will show, most games ended by round 2.

6 Results of Experiment and Vignette

In the first part of this section, we present the results from the vignette, which are considered as fairness assessments from the impartial perspective of spectators, and subjects' responses to the fairness question, which are considered as fairness assessments from the partial perspective of stakeholders. The fairness standards discussed above are used to evaluate these results. Subsequently, we present the outcomes from the three bargaining procedures which are then evaluated using the fairness assessments from the partial and impartial perspective.

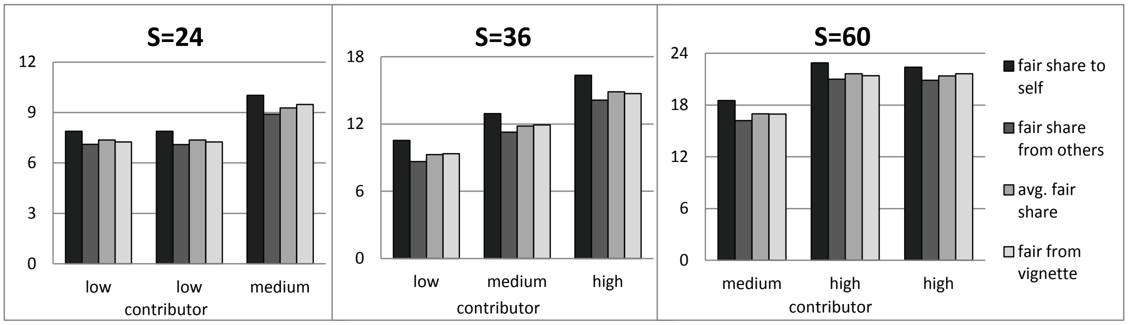
6.1 Outcomes of Vignette and Fairness Question

Depending on S we analyze 67-70 observations per cake size for the vignette, and 68 observations per partner and cake size for the fairness question.[12] Both answers are based on the same information, that is, for each of the three cake sizes, participants in the vignette are informed about the contributions in points of the three partners and are asked what they consider a fair division. Figure 1 displays the results, distinguishing for the answers to the fairness question between what subjects consider as fair for themselves (*fair share to self*), what the two partners on average assign to them (*fair share from others*), and the average share each partner is assigned in a partnership (*avg. fair share*).[13] This distinction clearly reveals the self-serving bias in the fairness evaluations of stakeholders: The amount subjects state as fair for themselves is significantly higher than what others consider fair for them for all cake sizes and all contribution types (pairwise t-test and Wilcoxon signed-rank test, WSR: $p < 0.01$ for all comparisons). Interestingly, the fairness assessments of the impartial spectators in the vignette are very similar to the average fair share in the fairness question. In fact, a pairwise t-test shows no significant differences for all cake sizes and all contribution types between the average fair share from the fairness question and the respective vignette result. This is an important result, since it shows that the answers to the fairness question offer meaningful results: We are able to derive an impartial fairness assessment from these answers by correcting for the self-serving bias. Interestingly, taking a simple mean over all three statements seems to serve this purpose.

Next, we address the question whether the three normative standards discussed previously are reflected in partial and impartial fairness views. Table 3 shows which

[12] We had to exclude some of the answers to the vignette due to inadmissible statements, e.g. allocations that sum up to more than the cake size.

[13] *Avg. fair share* is calculated as $1/3\cdot$ *fair share to self* + $2/3\cdot$ *fair share from others.*



Notes. Fair shares from the vignettes study (*fair from vignettes*) are compared to what subjects in the fairness question consider fair for themselves (*fair share to self*), what the two partners on average assign to them (*fair share from others*), and the average share each partner is assigned in a partnership (*avg. fair share*).

Figure 1: Division Assignments in Vignette and Fairness Question

proportions of the results reflect the egalitarian, the proportional, and the liberal standard, respectively. The *classification rate* sums up these proportions, thus displaying how many observations are consistent with any one of the three standards. Note that even if subjects adhere to a given fairness norm, we would expect some deviations from the point predictions of Table 2 due to rounding of numbers, a preference for integers, or similar things. Accounting for such deviations, but at the same time keeping the separation between standards as clear as possible in the classification, we allow for intervals that round numbers to the next half unit in case the standard does not yield integers.[14] One may suspect that the relatively high classification rate for $S = 24$ in both assessments is simply due to the fact that for a sufficiently small cake size our classification intervals do not leave much room for unclassified allocations. This objection, however, does not hold for S=60, where we also observe a high classification rate, and it does not explain the difference in classification rates between the large and medium cake size. For the vignette, we observe that in partnerships where two partners contribute the same amount (that is, in cake sizes $S = 24$ and $S = 60$), well over 80% of all

[14]We have one exception for the case of $S = 60$, where we consider observations that assign a share in the larger interval $[17, 18]$ to the medium contributor (and the rest equally to the two high contributors) as consistent with the liberal standard. The reason for this exception is that if both high contributors are rounded from 21.45 to 21, then this leaves 18 for the medium contributor. We consider this allocation of $[18, 21, 21]$ as consistent with the liberal standard. While this is certainly an ad-hoc criterion, we tried other criteria such as allowing for a fixed deviation in both directions of a point prediction, and results are rather stable.

assignments are consistent with one of the three fairness standards. In the fairness question, this fraction is somewhat lower, which is probably due to the self-serving bias in fairness evaluations of stakeholders. However, when all partners contribute different amounts, the fraction of unclassified observations is considerably higher both in the vignette and in the fairness question: For $S = 36$ almost 40% of the observations in the vignette and more than 55% of the observations in the fairness question cannot be counted as reflecting any of these standards. This is consistent with our presumption that evaluations of claims are subjective in our scenario, i.e. it is not clear what constitutes a fair division of the cake. Overall, among the discussed standards, the proportional standard is the most prevalent in our data from both vignette and fairness question.[15] But, while $40 - 50\%$ of vignette assignments are consistent with proportionality, the support for this standard is lower in the fairness question, in particular for the medium and large cake size. In the fairness question, subjects who do not follow this standard deviate by assigning a larger share to the low contributors compared to what the proportional standard would predict (Wilcoxon rank sum test (MWU): $p < 0.01$ in $S = 24$ and $S = 36$). This observation is true not only for assignments counted as consistent with the egalitarian or the liberal standard, but rather for all other assignments. A similar result is true for the vignette, where in the small cake size almost 50% of the participants assign more than the proportional share to the low contributor, and in the medium cake size, where over 50% assign more than the proportional share to the low contributor. At the same time, the high contributor gets more than the proportional amount in only 10% of the cases. This indicates that also for impartial spectators a fairness norm that deviates from the proportional rule implements smaller payoff differences across subjects.

A basic fairness idea implies that equal efforts should result in equal shares of the cake. In our context, however, participants know that efforts, which are unobservable, may differ even when observable contributions are equal (and vice versa). It is therefore not clear whether subjects are willing to apply this horizontal fairness norm to contributions. We find that amongst subjects who have an equal-contribution partner over 84% assign equal shares to equal contributors, while their

[15]This is in line with the results by Schokkaert and Overlaet (1989) and Konow (1996), who find evidence for proportionality using vignettes with different scenarios varying inputs (that affect output) as well as other factors (that do not affect output).

	Vignette				Fairness Question			
Cake Size	Small	Medium	Large	Pooled	Small	Medium	Large	Pooled
Egalitarian Std	0.16	0.11	0.15	0.14	0.33	0.15	0.27	0.25
Proportional Std	0.49	0.41	0.47	0.46	0.45	0.24	0.26	0.32
Liberal Std	0.23	0.10	0.21	0.18	0.04	0.04	0.15	0.08
Classification Rate	0.88	0.62	0.83	0.78	0.82	0.43	0.68	0.65

Notes. For each fairness view the fraction of observations consistent with their point predictions are listed. The classification rate sums up these fractions. For non-integer predictions intervals that round to the next half unit are allowed.

Table 3: Fairness Standards Observed in Vignette and Fairness Question

partners who made a different contribution to the cake size assign equal shares to equal contributors in over 90% of the cases. In the vignette, over 90% of all assignments reflect the idea of equal shares to equal contributors, which supports the importance of this horizontal fairness idea even with imperfect information about efforts. But note that this notion also includes the egalitarian division, which (in our design) is in conflict with the idea that *only* equal contributions should be rewarded with equal shares. Counting only cases where equal contributors are rewarded with equal shares while higher (lower) contributors are rewarded with higher (lower) shares, the assignments consistent with this idea in the fairness question decreases sharply, in particular for subjects who would profit from an equal division: In the small cake size, 50% of subjects in the role of low contributors assign equal shares to equal contributors (and unequal shares to unequal contributors), while 73% do so in the role of medium contributors. Low contributors thus follow the egalitarian standard significantly more often than medium contributors in $S = 24$ (40% vs. 20%; χ^2-test: $p < 0.01$), as they profit most from this standard. In the large cake size, about 60% of both contribution types assign equal shares to equal contributors and a lower share to the partner who contributed less. Also, for this cake size, where only medium and high contributors are present, partners with the relatively lower contribution follow the egalitarian standard more often (35% vs. 22%, χ^2-test: $p < 0.05$), but this tendency is less pronounced than when the low-contribution partner is involved. For the vignette, where impartial observers are asked to make assignments, over 77% of the participants reward not only equal shares to equal contributors, but also different rewards to different contributors. The egalitarian standard plays only a minor role with $10 - 15\%$ of the observations. These differences between fairness norms of stakeholders and impartial observers extend the results of Konow et al. (2009) as well as Rodriguez-Lara and Moreno-Garrido (2012) for the case of unobservable efforts and non-linear production, and they stand in contrast to Fischabcher et al. (2009). Our findings below will show that not only the self-serving bias as stakeholder but also the strategic role in bargaining has an impact on which fairness ideas are reflected in bargaining outcomes.

6.2 Bargaining Outcomes: Descriptive Results and Non-Parametric Tests

We now present the main results regarding bargaining outcomes and their fairness assessments from the partial and impartial view.

cake size	Small			Medium			Large		
player	1	2	3	1	2	3	1	2	3
contribution	2	3	2	3	2	4	4	4	3
fair from vignette	7.26	9.48	7.26	11.93	9.35	14.72	21.42	21.62	16.96
avg. fair share	7.36	9.27	7.37	11.82	9.29	14.88	21.65	21.38	16.97
Demand Variant									
prediction	8.86	7.97	7.17	13.28	11.96	10.76	22.14	19.93	17.93
initial demand	7.77	9.55	7.90	12.50	11.68	15.14	21.98	22.18	18.75
proposal in round 1	7.77	9.50	6.72	12.50	10.63	12.86	21.98	21.61	16.41
realized payoff	7.17	8.77	7.32	11.64	10.19	13.05	20.82	20.32	16.98
Offer Variant									
prediction	8.86	7.97	7.17	13.28	11.96	10.76	22.14	19.93	17.93
initial demand	7.70	9.05	8.05	12.41	10.36	13.91	21.61	21.73	18.79
proposal in round 1	7.70	8.73	7.57	12.41	9.64	13.95	21.61	20.25	18.14
realized payoff	7.31	8.30	7.31	11.45	9.57	13.21	20.75	20.68	17.75
Exit Variant									
prediction	8.57	7.71	7.71	12.86	11.57	11.57	21.43	19.28	19.28
initial demand	7.58	9.83	8.46	12.29	10.79	15.54	21.39	21.29	18.62
proposal in round 1	7.58	8.85	7.57	12.29	9.17	14.54	21.39	20.85	17.76
realized payoff	7.15	8.68	7.53	10.70	9.06	13.90	19.42	20.65	18.03

Table 4: *Demand*, *Offer*, and *Exit* Variant: Predictions, Proposals and Payoffs

Duration and Efficiency. Over 88% of the games ended by round 2 for all bargaining variants and cake sizes and the proportion of the initially available cake size that was finally paid out to the partners was well over 90% for all of them. Comparing the three procedures we see that, on average, bargaining in the *Exit* variant takes longer than in the *Demand* and in the *Offer* variant (Kruskal-Wallis: $p < 0.05$, pooled for all cake sizes). Also, the extremes are more pronounced in the *Exit* variant. Indeed, only for the *Exit* variant we observe cases where bargaining exceeds three rounds – in all those cases, one partner has left while the other two continue to bargain. Overall, the option to exit was taken in 30% of all games for cake size $S = 24$, in 54% of the games for $S = 36$, and in 42% of the games for $S = 60$.

Proposed and Implemented Allocations. Table 4 displays the inputs and outputs of the three bargaining procedures and some variables that might help to explain them. The top block displays the contributions of the three players in points (*contribution*) as well as the fairness evaluations of spectators (*fair from vignette*) and stakeholders (*avg. fair share*). Within the procedure-specific blocks the first row (*prediction*) contains the equilibrium prediction as described in section 3.[16] It is important to note that these predictions imply a first mover advantage in all bargaining procedures. The second row (*initial demand*) exploits the fact that all subjects were asked to enter a pre-play proposal conditional on being player 1 before they were informed of their actual position in the move-order of the game. Note that these initial proposals were binding for the actual player 1. Since the *Demand* variant, in contrast to the *Offer* and the *Exit* variant, does not ask for a complete division proposal but only for a proposal regarding one's own share, we use only the pre-play proposal regarding one's own share for all three bargaining variants in the row *initial demand* in order to make entries comparable across procedures. The third row (*proposal in round 1*) contains the actual division proposal in round 1. For the *Offer* and the *Exit* variant this corresponds to the pre-play division proposal of the subject who was actually assigned the role of player 1. For the *Demand* variant, the entry in *proposal in round 1* for player 1 is identical to his *initial demand*, the entry for player 2 is his actual demand in round 1, and for player 3 it is the remainder of the cake after the entries of players 1 and 2 have

[16]Recall that the assumption of common knowledge that all players are rational and only interested in their own material income yields a unique SPE for the *Exit* variant. For the *Demand* variant and the *Offer* variant (where this assumption does not yield a point prediction) we give the unique stationary SPE outcome as a reference here. The predictions are referred to mainly for the sake of completeness, since it is known from the vast literature on bargaining experiments that not only the bargaining parameters, protocol, and players' strategic position, but also fairness considerations and self-serving bias determine bargainers' behavior.

been subtracted. The last row in the procedure-specific blocks lists the realized payoff for each of the three players.

Realized Payoffs vs. Standard Predictions. As expected, the point predictions for all three bargaining variants fail largely. This is particularly evident for the medium cake size, where realized payoffs differ from predictions at high significance levels for all bargaining variants and all player roles. For the small and large cake size we find similar differences only for players 1 and 2: Player 1 gets less and player 2 gets more than predicted (t-test, WSR and sign test are all significant at common levels for all comparisons). Note that the significant deviations from the predictions for players who are not first movers always go in the direction of rewarding higher contributions with higher payoffs, which stands in contrast to the standard prediction, where subjects are not motivated by entitlements and effort is treated as sunk cost. Another important observation is that even when two players have equal contributions, there is no first-mover advantage for player 1: Comparing the payoff of player 1 to that of player 3 in the small cake size (where both are low contributors), and the payoff of player 1 to that of player 2 in the large cake size (where both are high contributors), we find no significant differences, neither in the *Demand* variant (MWU: $p = 0.56$ and $p = 0.53$ for small and large cake size), nor in the *Offer* variant (MWU: $p = 1.00$ and 0.97 for small and large cake size). In the *Exit* variant, the first mover even has a disadvantage: Despite equal contributions, he receives less than the last mover in the small cake size (MWU: $p = 0.11$), and less than the second mover in the large cake size (MWU: $p < 0.02$). This is a surprising result, on which we will elaborate further below, as it points towards an important effect of the *Exit* variant on proposer behavior and bargaining outcome.

Realized Payoffs vs. Contributions. For all bargaining variants, realized payoffs reflect the order of contributions when players' contributions differ, as shown in Table 4. Indeed, the higher contribution partner systematically receives more than the equal split and the lower contribution partner receives less (WSR: $p < 0.01$ for all bargaining procedures and all cake sizes). This result is in line with the findings of Gächter and Riedl (2005) and Frohlich et al. (2004) for a setting with objective claims, where subjects were found to have a tendency to reward individual contributions. Testing for proportionality of realized payoffs to contributions in points shows that the partner who contributes more within a given cake size receives less than the proportional share, while the partner who contributes less receives more than the proportional share ($p < 0.05$ for all bargaining procedures and all cake sizes).[17] We will look at the role of prominent fairness standards for initial proposals and realized payoffs in more detail below.

Proposals in Round 1 and Realized Payoffs Compared Across Procedures. The fact that the *Demand* variant does not require player 1 to make a full division proposal has an immediate effect on the *proposal in round 1*: While player 1's entry does not differ across the three variants, player 2's entry in *proposal in round 1* is highest in the *Demand* variant (Kruskal-Wallis: $p = 0.08$ pooled for all cake sizes), where – in contrast to the *Offer* and *Exit* variant – he can decide himself on this entry. Note that in the *Offer* and the *Exit* variant, *initial demand* always exceeds the respective entry in *proposal in round 1* for player 2 and player 3. By contrast, in the *Demand* variant, the difference between the entry in *proposal in round 1* and *initial demand* is significant only for player 3 (WSR: $p < 0.02$ for all cake sizes), while it is insignificant for player 2 (and not present by design for player 1). Thus, the *Demand* variant leaves systematically less on the table for player 3. In a comparison across procedures, the difference between player 3's entry in *proposal in round 1* and his *initial demand* is largest in the *Demand* variant and smallest in the *Offer* variant (Kruskal-Wallis: $p < 0.002$, pooled for all cake sizes), which again confirms that player 3 is systematically disadvantaged when each player is asked to make only a proposal regarding the own share. While in the small cake size this disadvantage is not readily apparent from mean realized payoffs, it becomes so when looking at the means of rejected proposals in round 1: For $S = 24$, rejected proposals in the *Demand* variant (23% rejection rate) have a mean value of 4 for the share of player 3, while in the *Offer* variant (36% rejection rate) the mean of this share in rejected proposals is 7.4, and in the *Exit* variant only 2 proposals – both with shares of 7 for player 3 – were rejected.[18] Another

[17] The medium contributor in $S = 36$ is an exception here, as his realized payoff is not significantly different from the payoff derived from any of the three standards, which is always 12.

[18] Note that for the *Offer* variant, we have to count rejections of both player 2 and player 3, since after a rejection of player 2, the game proceeds to a new round and we cannot tell whether player 3 would have rejected. But even if we take only offers that are explicitly rejected by player 3 (and accepted by player 2), the mean is 7.2.

affirmation of the disadvantage of being player 3 in the *Demand* variant is that in about one fifth of the cases, player 3's share in *proposal in round 1* is 6 or below, which does not happen in the other two bargaining variants where a full division proposal is required. On the other hand, the *Exit* variant yields an advantage for player 3: His entry in *proposal in round 1* is higher compared to the *Demand* variant (MWU: $p < 0.1$), and it is not different from the *Offer* variant. Combined with the possibility to exit, this has a direct implication for realized payoffs: The Kruskal-Wallis test shows that player 3's share of the cake is different in the three bargaining procedures ($p < 0.1$ for small cake size, $p < 0.08$ for medium and $p < 0.05$ for large cake size) – the highest share is always obtained in the *Exit* variant, and the lowest in the *Demand* variant. If we compare payoff levels, the different rules of the procedures imply that player 3, on average, receives a higher realized payoff in the *Exit* variant in a pairwise comparison with the *Demand* variant (t-test: $p < 0.13$ for small cake size, $p < 0.09$ for medium and $p < 0.07$ for large cake size). This goes at the expense of player 1, who receives least in the *Exit* variant (t-test significant for medium and large cake size at $p < 0.02$ for pairwise comparisons with *Demand* and *Offer* variant). For player 2, we find no systematic differences in payoffs across bargaining procedures.

The Role of Prominent Fairness Standards for Proposals in Round 1 and Realized Payoffs. Table 5 shows the fraction of observations for *proposal in round 1* and *realized payoff* that are classified as reflecting the egalitarian, the proportional and the liberal fairness standard. The criteria for assignment towards a standard are as described in Section 4.[19] Table 5 reveals the following regularities: (1) Pooling over cake sizes, a considerable fraction of the observations for both *proposal in round 1* as well as *realized payoff* is classified as consistent with one of the fairness standards, as was the case for vignettes and fairness question. (2) A comparison by cake size shows significant differences for the three variants in the small and large cake size. The classification rates are over 75% in the *Offer*

[19] For the classification of bargaining outcomes in the *Exit* variant this delineation has some shortcomings. For instance, when one player used the option to exit, it is not clear how to classify allocations in which the payoff of this partner hints at a different fairness notion than the payoffs of the two remaining subjects. Furthermore, if two equal-contribution partners are left, an equal split could be assigned to all three fairness norms. In our analysis there were only few such cases, which we leave out in the classification in Table 5. In total, 9 out of 204 cases (less than 5 percent) were unclear.

Cake Size	Small			Medium			Large			Pooled		
Variant	*Demand*	*Offer*	*Exit*	*Demand*	*Offer*	*Exit*	*Demand*	*Offer*	*Exit*	*Demand*	*Offer*	*Exit*
Egalitarian Std												
proposal in round 1	0.14	0.50	0.50	0.35	0.15	0.11	0.14	0.42	0.21	0.21	0.36	0.27
realized payoff	0.15	0.55	0.36	0.32	0.14	0.08	0.19	0.45	0.23	0.22	0.38	0.22
Proportional Std												
proposal in round 1	0.27	0.32	0.32	0.04	0.04	0.32	0.09	0.18	0.27	0.13	0.18	0.30
realized payoff	0.30	0.20	0.23	0.05	0.10	0.17	0.05	0.18	0.18	0.13	0.16	0.19
Liberal Std												
proposal in round 1	0.00	0.13	0.17	0.04	0.14	0.08	0.08	0.17	0.17	0.04	0.15	0.14
realized payoff	0.10	0.25	0.18	0.05	0.15	0.05	0.09	0.18	0.18	0.08	0.19	0.14
Classific. Rate												
proposal in round 1	0.41	0.95	0.99	0.43	0.33	0.51	0.31	0.77	0.65	0.38	0.68	0.72
realized payoff	0.55	1.00	0.77	0.37	0.39	0.30	0.33	0.81	0.59	0.42	0.73	0.55

Notes. The fraction of observations, which are consistent with the different fairness standards are listed, for the actual division *proposal in round 1* as well as the *realized payoffs*. The classification rate sums up the fractions. For non-integer predictions intervals that round to the next half unit are allowed.

Table 5: Fairness Standards Observed in Initial Proposals and Payoffs in Bargaining

variant and over 60% in the *Exit* variant, while they are only $30 - 55\%$ in the *Demand* variant. The particularly high rates for the small cake size are arguably in part due to the fact that plausible fair allocations lie rather close together here. For the *Demand* variant's low classification rates we see two possible explanations, both originating from the rule of asking only for one's own share. On the one hand, it fosters the self-serving bias of player 2, who, as already noted, asks for more in this variant, thus the complete vector of *proposal in round 1* may be inconsistent with any fairness standard. On the other hand, even with fair-minded players, it may well be that player 1 and player 2 endorse different fairness standards, and therefore, *proposal in round 1*, which is composed of demands from these two players, as well as the *realized payoff*, which is derived from a proposal in the final round, may be inconsistent with any fairness standard. As a result, this rule is distortive with regard to fair outcomes. (3) The classification rates in the medium cake size are similar and relatively low (between one-third and one-half) across all bargaining variants. This is consistent with our finding that there is much more heterogeneity in fairness views when all players make different contributions. (4) For the *Exit* variant, *proposal in round 1* often reflects one of the fairness standards; however, *realized payoff* does not. This is consistent with our earlier finding that the option to exit introduces a distortion with respect to fair payoffs, in particular when contributions are equal. (5) Compared to the results from the fairness question and vignette, the proportional standard plays a minor role for both *proposal in round 1* and *realized payoff*. This is consistent with other experimental results, such as Konow et al. (2009).

The Role of Partial and Impartial Fairness Assessments for Proposals in Round 1 and Realized Payoffs. As a measure for how close bargaining outcomes come to participants' partial and impartial fairness assessments, we consider the absolute deviation of *proposal in round 1* and *realized payoff* from *avg. fair share* as calculated from the fairness question.[20] In pairwise comparisons between the *Offer* and *Exit* variant, we find no significant differences in deviations of *proposal in round 1* from *avg. fair share*. The *Demand* variant, on the other hand, shows higher deviations for player 2 compared to the *Exit* variant (t-test: $p < 0.03$), and for player 3 it shows higher deviations than the *Exit* variant (t-

[20] We only use stakeholders' own fairness considerations, knowing that they come very close to impartial spectators' assignments in *fair from vignette*, thus yielding similar results.

test: $p = 0.11$) as well as the *Offer* variant (t-test: $p < 0.1$). This is another affirmation of our finding that the *Demand* variant is distortive through its rule of asking for own demands only. The *proposal in round 1* in *Offer* and *Exit* variant show more accordance with the three fairness norms we considered, and they show more accordance with stakeholders' own fairness considerations. However, the *Exit* variant cannot keep this promising initial proposal: Looking at the deviation of *realized payoff* from *avg. fair share*, the *Exit* variant yields a worse result than both *Offer* and *Demand* variant for player 1 (t-test: $p < 0.01$). The *Offer* variant also yields a better result (lower deviation) for player 2 compared to the *Demand* variant (t-test: $p < 0.02$). While no other differences are significant, this points to the result that amongst our three bargaining procedures, the *Offer* variant comes closest to *avg. fair share*, which we use as a measure of fairness from a partial view, and due to similar results on average in the vignette, the *Offer* variant also comes closest to *fair from vignette*.

6.3 Bargaining Outcomes: Econometrics

The Role of Contribution, Bargaining Procedure and Player Role for Realized Payoffs. Table 6 shows the results of regressions for the realized payoffs controlling for contributions, bargaining procedures and player roles with dummy variables using effect coding.[21] Regressions are run separately for each cake size, since the position in bargaining given each contribution was fixed within cake size.[22] The results confirm our descriptive findings. In the *Demand* variant, player 2 profits from being able to make a proposal for the own share, while player 3 is disadvantaged from the last-mover position as he is suggested to just collect the leftovers. In the *Exit* variant, player 3 receives a higher payoff while players 1 and 2 receive significantly less compared to the grand mean over all treatments and groups. The *Exit* variant's particular feature, allowing a player to leave with his current offer, results in this different treatment of the last mover and stands in sharp contrast to the *Demand* variant's rule of asking only for a proposal regarding the own share without forcing the player to explicitly consider other players' shares.

[21] With effect coding we analyze deviations from the (un-weighted) grand mean, the mean of all observations across all groups, equal to the constant.

[22] Recall that for the sake of comparability of payoffs of a given contribution type, we keep the move order fixed across bargaining procedures within a given cake size (see Table 1).

	(cs 24)	(cs 36)	(cs 60)
Const.	7.946***	11.419***	18.921***
	(0.152)	(0.108)	(0.163)
Player1	-0.054	-0.065	-0.220
	(0.085)	(0.182)	(0.198)
Player2	-0.014	-0.547***	-0.411*
	(0.118)	(0.177)	(0.243)
Player3	0.068	0.612***	0.631*
	(0.098)	(0.196)	(0.326)
*Demand**Player1	0.013	0.333	0.522*
	(0.121)	(0.204)	(0.265)
*Demand**Player2	0.277**	0.582**	0.266
	(0.130)	(0.240)	(0.280)
*Demand**Player3	-0.290**	-0.915***	-0.788**
	(0.133)	(0.233)	(0.323)
*Offer**Player1	-0.019	0.198	0.035
	(0.115)	(0.190)	(0.258)
*Offer**Player2	-0.030	0.010	0.283
	(0.122)	(0.204)	(0.263)
*Offer**Player3	0.049	-0.208	-0.318
	(0.107)	(0.201)	(0.318)
*Exit**Player1	0.005	-0.531**	-0.557**
	(0.110)	(0.221)	(0.277)
*Exit**Player2	-0.247*	-0.592**	-0.549**
	(0.126)	(0.257)	(0.259)
*Exit**Player3	0.242**	1.123***	1.106***
	(0.102)	(0.235)	(0.295)
Demand	0.024	0.210	-0.118
	(0.091)	(0.156)	(0.210)
Offer	-0.085	-0.008	0.236
	(0.080)	(0.139)	(0.198)
Exit	0.060	-0.202	-0.118
	(0.080)	(0.161)	(0.190)
lowcontrib	-0.654***	-1.612***	
	(0.094)	(0.184)	
medcontrib	0.654***	-0.067	-1.709***
	(0.094)	(0.186)	(0.240)
highcontrib		1.678***	1.709***
		(0.205)	(0.240)
N	204	204	204
R^2	0.374	0.571	0.376

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes. For each cake size the *realized payoff* is regressed on contribution and categorical variables for the bargaining variant interacted with the bargaining position, using effect coding. Robust standard errors in parantheses.

Table 6: Regression on Payoffs in the Three Bargaining Procedures

However, as already noted, the *Exit* variant also leads to a distorted outcome in the sense that player 1 receives a lower payoff than the same-contribution partner in the small and large cake size, while this is not the case in the *Demand* and the *Offer* variant. The effect of players' contributions on payoffs go in the expected direction for the low and high contribution type, which confirms the conclusion that fairness plays an important role in bargaining with subjective claims. For the medium contributor, the results shows that not only absolute but also relative contributions affect players' payoffs: In the small cake size, where the medium contributor is the relatively higher contributor, the effect is positive, while in the large cake size, where he is the relatively lower contributor, it is negative.

	Demand		***Offer***		***Exit***	
Variable	Coefficient	(Rob. SE)	Coefficient	(Rob. SE)	Coefficient	(Rob. SE)
avg. fair share	0.186	(0.118)	0.208**	(0.101)	0.063	(0.060)
low contrib	-1.082***	(0.375)	-1.177***	(0.258)	-1.923***	(0.258)
med contrib	-0.284*	(0.171)	-0.351***	0.134)	-0.215	(0.157)
high contrib	1.366***	(0.455)	1.528***	(0.279)	2.138***	(0.298)
small cakesize	-3.355***	(0.463)	-3.270***	(0.432)	-3.314***	(0.267)
med cakesize	-1.040***	(0.244)	-1.238***	(0.185)	-1.491***	(0.182)
large cakesize	4.395***	(0.647)	4.508***	(0.578)	4.805***	(0.356)
Player 1	0.296**	(0.148)	0.117	(0.126)	-0.393**	(0.153)
Player 2	0.101	(0.170)	-0.194	(0.131)	-0.705***	(0.163)
Player 3	-0.397**	(0.181)	0.077	(0.139)	1.098***	(0.152)
const	10.432***	(1.609)	10.147***	(1.347)	11.952***	(0.800)
	N = 198		N = 198		N = 216	
	$\overline{R}^2 = 0.904$		$\overline{R}^2 = 0.938$		$\overline{R}^2 = 0.914$	
					*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$	

Notes. The *realized payoff* is regressed on the average fairness evaluation of the stakeholders, *avg. fair share*, controlling for contribution, cake size, and bargaining position with effect coding. Robust standard errors in parantheses.

Table 7: Regression of Payoffs on Average Fair Shares From Fairness Question

Realized Payoffs and Fairness Assessments. Table 7 shows the results of a regression run separately for each bargaining variant with *avg. fair share* as the main independent variable, where we control for cake size, contribution, and player role with dummy variables using effect coding.[23] The results largely confirm our previous results. First, they show a significant positive effect of *avg. fair*

[23]Since the assignments considered as fair by impartial spectators are very similar to the group averages of assignments in the fairness question, we again take the variable *avg. fair share* as main indicator for what is considered a fair allocation by partners and spectators.

share on the payoff in the *Offer* variant, but not in the *Demand* and *Exit* variant. This underlines the finding that the *Offer* variant is least distortive with regard to fair bargaining outcomes. Second, a low contribution generally has a negative effect on the payoff s_i, while a high contribution has a positive effect.[24] Third, the regression confirms our former findings regarding the effect of the bargaining rules: In the *Demand* variant, player 3 is systematically disadvantaged, while player 1 is favored. The opposite is true for the *Exit* variant. Most striking, finally, is the result for the *Offer* variant. Players' move order has no significant effect on payoffs whatsoever. That is, this procedure does not influence the bargaining outcome in a systematic way, thus providing the cleanest transformation of subjective claims into allocations within our bargaining environment. *Demand* and *Exit* variant provide the described distortive incentives, and we find that although people initially adhere to certain fairness norms as revealed in the answers to the fairness question, they exploit "the strategic realities of the situation" (Binmore 1991) when asked to reach an agreement on the actual division via bargaining.

7 Conclusion

When several agents have contributed towards the production of a cake, but their efforts are unobservable and their contributions difficult to compare, agents are likely to have different perceptions on what constitutes a fair division of the cake. It is then difficult to find a division the involved partied are content with. In search for a solution for such a subjective claims problem, this paper compared the outcomes of three unanimity bargaining procedures with respect to fairness and efficiency. As a measure of the fairness of an outcome we used the results of a vignette indicating which allocations are considered fair by impartial outside observers, and we also used the results of a fairness question posed to (partial) stakeholders in the bargaining experiment. A further measure employed are nor-

[24] We ran a further regression where *realized payoff* is explained as a fraction of the respective amount derived from the proportional fairness standard (s_i/s_i^{prop}) as a robustness check for our finding that allocations seem to be more equal than the proportional standard would predict.Indeed we find that contribution levels have a reversed effect on s_i/s_i^{prop}, that is, the fraction of realized payoff relative to the proportional standard is significantly higher for low contributors and lower for high contributors for all bargaining variants. Thus, while contributions are acknowledged, differences in payoffs are reduced compared to a division according to the proportional standard. This in line with our findings from vignette and fairness question.

mative fairness standards such as the proportional or the egalitarian standard that play a prominent role in objective claims problems.

While partial fairness assessments were found to be distorted by a self-serving bias, a simple group average of the agents' assessments turned out to yield similar results as the impartial fairness assessments from the vignette. A fair division derived from these assessments qualitatively reflects contribution levels, but to a lesser extent than the proportional standard would suggest. We found significant differences in the degree to which bargaining outcomes come close to this fair division. When each player is only asked to make a proposal regarding the own share – as in the *Demand* variant of unanimity bargaining – the last player is disadvantaged, as the other players take too much compared to what is considered fair by stakeholders and outside observers. When a player may leave the bargaining table as soon as he is satisfied with the share he is currently offered – as in the *Exit* variant – the first mover is disadvantaged, since he has to remain at the bargaining table until all players agree, and agreements are reached later in this variant. When the proposing player has to make a complete division proposal, to which all other players have to agree – as in the *Offer* variant – bargaining outcomes are more closely in line with the varying fairness measures we use. Indeed, the payoffs achieved in the *Offer* variant show the smallest deviations from the impartial and the corrected partial fairness assessment, and they also reflect normative fairness standards more often than the outcomes of the other two bargaining variants.

8 References

Ashlagi, I., Karagözoglu, E., and Klaus, B. (2012). A Non-cooperative Support for Equal Division in Estate Division Problems. Mathematical Social Sciences 63 (3), pp. 228-233.

Babcock, L., Loewenstein, G., Issacharoff, S., and Camerer, C. (1995). Biased Judgments of Fairness in Bargaining. American Economic Review 85 (5), pp. 1337-1343.

Babcock, L., Wang, X., and Loewenstein, G. (1996). Choosing the Wrong Pond: Social Comparisons that Reflect a Self-serving Bias. Quarterly Journal of Economics 111 (1), pp. 1-19.

Baron, D.P. and Ferejohn, J.A. (1987). Bargaining and Agenda Formation in Legislatures. American Economic Review 77 (2), Papers and Proceedings of the Ninety-Ninth Annual Meeting of the American Economic Association, pp. 303-309.

Baron, D.P. and Ferejohn, J.A. (1989). Bargaining in Legislatures. American Political Science Review 83 (4), pp. 1181-1206.

Binmore, K., (1991). Do People Exploit their Bargaining Power? An Experimental Study. Games and Economic Behavior 3 (3), pp. 295-322.

Burrows, P. and Loomes, G. (1994). The Impact of Fairness on Bargaining Behavior. Empirical Economics 19 (2), pp. 201-221.

Camerer, C. (2003). Behavioral Game Theory: Experiments in Strategic Interaction. Princeton: Princeton University Press.

Cappelen, A., Drange, A., Sorensen, E., and Tungodden, B. (2007). The Pluralism of Fairness Ideals: An Experimental Approach. American Economic Review 97 (3), pp. 818-827.

Dana, J., Weber, R. A., and Kuang, J. X. (2005). Exploiting Moral Wiggle Room: Experiments Demonstrating an Illusory Preference for Fairness. Economic Theory 33 (1), pp. 67-80.

Diermeier, D. and Morton, R. (2004). Proportionality versus Perfectness: Experiments in Majoritarian Bargaining. In: David Austen-Smith and John Duggan (Eds.). Social Choice and Strategic Behavior: Essays in the Honor of Jeffrey S. Banks. Berlin: Springer, pp. 201-227.

Diermeier, D. and Gailmard, S. (2006). Self Interest, Inequality, and Entitlement in Majoritarian Decision-Making. Quarterly Journal of Political Science 1 (4), pp.

327-350.

Fischbacher, U. (2007). Z-Tree: Zurich Toolbox for Ready-made Economic Experiments, Experimental Economics 10 (2), pp. 171-178.

Fischbacher, U., Kairies, N., and Stefani, U. (2009). Performance, Productivity and Fairness: An Experiment an the Distribution of Joint Production. Discussion Paper Series in Economics and Management No. 09-12.

Frechette, G.R., Kagel, J.H., and Lehrer, S.F. (2003). Bargaining in Legislatures: An Experimental Investigation of Open Versus Closed Amendment Rules. American Political Science Review 97 (2), pp. 221-232.

Frechette, G.R., Kagel, J.H., and Morelli, M. (2005a). Gamson's Law Versus Non-cooperative Bargaining Theory. Games and Economic Behavior, Vol. 51 (2), pp. 365-390.

Frechette, G.R., Kagel, J.H., and Morelli, M. (2005b). Behavioral Identification in Coalitional Bargaining: An Experimental Analysis of Demand Bargaining and Alternating Offers. Econometrica 73 (6), pp. 1893-1937.

Frohlich, N., Oppenheimer, J., and Kurki, A. (2004). Modeling Other-Regarding Preferences and an Experimental Test. Public Choice 119 (1/2), pp. 91-117.

Gantner, A., Güth, W., and Königstein, M., (2001). Equitable Choices in Bargaining Games with Production. Journal of Economic Behavior and Organisation 46 (2), pp. 209-225.

Gächter, S. and Riedl, A. (2005). Moral Property Rights in Bargaining with Infeasible Claims. Management Science 51 (2), pp. 249-263.

Gächter, S. and Riedl, A. (2006). Dividing Justly in Bargaining Problems with Claims. Social Choice and Welfare 27 (3), pp. 571-594.

Güth, W., Huck, S., and Ockenfels, P. (1996). Two-Level Ultimatum Bargaining with Incomplete Information: An Experimental Study. The Economic Journal 106 (436), pp. 593-604.

Güth, W. and van Damme, E. (1998). Information, Strategic Behavior, and Fairness in Ultimatum Bargaining: An Experimental Study. Journal of Mathematical Psychology 42 (2-3), pp. 227-247.

Herrero, M. (1985). A Strategic Bargaining Approach to Market Institutions. Unpublished Ph.D. thesis, London University.

Herrero, C., Moreno-Ternero, J. D., and Ponti, G. (2010). On the Adjudication of Conflicting Claims: An Experimental Study. Social Choice and Welfare 34 (1), pp. 145-179.

Hoffman, E. and Spitzer, M.L. (1985). Entitlements, Rights, and Fairness: An Experimental Examination of Subjects' Concepts of Distributive Justice. Journal of Legal Studies 14 (2), pp. 259-297.

Kagel, J., Kim, C., and Moser, D. (1996). Fairness in Ultimatum Games with Asymmetric Information and Asymmetric Payoffs. Games and Economic Behavior 13 (1), pp. 100-110.

Karagözoglu, E. and Riedl, A. (2010). Information, Uncertainty, and Subjective Entitlements in Bargaining. IZA Discussion Papers 5079, Institute for the Study of Labor (IZA).

Karagözoglu, E. (2012). Bargaining Games with Joint Production. In: Bolton, G. and Croson, R. (Eds.). Oxford Handbook of Economic Conflict Resolution. Oxford University Press, New York.

Konow, J. (1996). A Positive Theory of Economic Fairness. Journal of Economic Behavior and Organization 31 (1), pp. 13-35.

Konow, J. (2000). Fair Shares: Accountability and Cognitive Dissonance in Allocation Decisions. American Economic Review 90 (4), pp. 1072-1092.

Konow, J. (2003). Which Is the Fairest One of All? A Positive Analysis of Justice Theories. Journal of Economic Literature 41 (4), pp. 1188-1239.

Konow, J., Saijo, T. and Akai, K. (2009). Morals and Mores: Experimental Evidence on Equity and Equality. Levine's Working Paper Archive 122247000000002055, David K. Levine.

Krishna, V. and Serrano, R. (1996). Multilateral Bargaining. The Review of Economic Studies 63 (1), pp. 61-80.

Loewenstein, G., Issacharoff, S., Camerer, C., and Babcock, L. (1993). Self-Serving Assessments of Fairness and Pretrial Bargaining. Journal of Legal Studies 22 (1), pp. 135-159.

Messick, D. and Sentis, K. (1979). Fairness and Preference. Journal of Experimental Social Psychology 15 (4), pp. 418-434.

Messick, D. and Sentis, K. (1983). Fairness, Preference and Fairness Biases. In: Messick, D. and Cook, K. (Eds.). Equity Theory: Psychological and Sociological Perspectives. New York: Praeger, pp. 61-94.

Miller, L. and Vanberg, C. (forthcoming). Decision Costs in Legislative Bargaining: An Experimental Analysis. Public Choice.

Morelli, M. (1999). Demand Competition and Policy Compromise in Legislative Bargaining. American Political Science Review 93 (4), pp. 809-820.

Moulin, H. (2002). Axiomatic cost and surplus sharing. In: Arrow, K.J., Sen, A.K., and Suzumura, K. (Eds.). Handbook of Social Choice and Welfare, Vol. I. Amsterdam: Elsevier, pp. 289-357.

Rodriguez-Lara, I. and Moreno-Garrido, L. (2012). Self-Interest and Fairness: Self-Serving Choices of Justice Principles. Experimental Economics 15 (1), pp. 158-175.

Ross, M. and Sicoly F. (1982). Egocentric Biases in Availability and Attribution. In: Kahnemann, D., Slovic, P. and Tversky, A. (Eds.). Judgment Under Uncertainty: Heuristics and Biases. Cambridge: Cambridge University Press, pp. 179-189.

Schokkaert, E. and Lagrou, L. (1983). An Empirical Approach to Distributive Justice. Journal of Public Economics 21 (1), pp. 33-52.

Schokkaert, E. and Overlaet, B. (1989). Moral Intuitions and Economic Models. Social Choice and Welfare 6 (1), pp. 19-31.

Sutton, J. (1986): Non-Cooperative Bargaining Theory: An Introduction, The Review of Economic Studies 53 (5), pp. 709-724.

Thomson, W. (2003). Axiomatic and Game Theoretic Analysis of Bankruptcy and Taxation Problems: A Survey. Mathematical Social Sciences 45 (3), pp. 249-297.

Torstensson, P. (2009). An n-Person Rubinstein Bargaining Game. International Game Theory Review 11 (1), pp. 111-115.

Yaari, M.E. and Bar-Hillel, M. (1984). On Dividing Justly. Social Choice and Welfare 1 (1), pp. 1-24.

University of Innsbruck - Working Papers in Economics and Statistics
Recent Papers can be accessed on the following webpage:

http://eeecon.uibk.ac.at/wopec/

2013-31 **Anita Gantner, Kristian Horn, Rudolf Kerschbamer:** Fair division in unanimity bargaining with subjective claims

2013-30 **Anita Gantner, Rudolf Kerschbamer:** Fairness and efficiency in a subjective claims problem

2013-29 **Tanja Hörtnagl, Rudolf Kerschbamer, Rudi Stracke, Uwe Sunde:** Heterogeneity in rent-seeking contests with multiple stages: Theory and experimental evidence

2013-28 **Dominik Erharter:** Promoting coordination in summary-statistic games

2013-27 **Dominik Erharter:** Screening experts' distributional preferences

2013-26 **Loukas Balafoutas, Rudolf Kerschbamer, Matthias Sutter:** Second-degree moral hazard in a real-world credence goods market

2013-25 **Rudolf Kerschbamer:** The geometry of distributional preferences and a non-parametric identification approach

2013-24 **Nadja Klein, Michel Denuit, Stefan Lang, Thomas Kneib:** Nonlife ratemaking and risk management with bayesian additive models for location, scale and shape

2013-23 **Nadja Klein, Thomas Kneib, Stefan Lang:** Bayesian structured additive distributional regression

2013-22 **David Plavcan, Georg J. Mayr, Achim Zeileis:** Automatic and probabilistic foehn diagnosis with a statistical mixture model

2013-21 **Jakob W. Messner, Georg J. Mayr, Achim Zeileis, Daniel S. Wilks:** Extending extended logistic regression to effectively utilize the ensemble spread

2013-20 **Michael Greinecker, Konrad Podczeck:** Liapounoff's vector measure theorem in Banach spaces *forthcoming in Economic Theory Bulletin*

2013-19 **Florian Lindner:** Decision time and steps of reasoning in a competitive market entry game

2013-18 **Michael Greinecker, Konrad Podczeck:** Purification and independence

2013-17 **Loukas Balafoutas, Rudolf Kerschbamer, Martin Kocher, Matthias Sutter:** Revealed distributional preferences: Individuals vs. teams

2013-16 **Simone Gobien, Björn Vollan:** Playing with the social network: Social cohesion in resettled and non-resettled communities in Cambodia

2013-15 **Björn Vollan, Sebastian Prediger, Markus Frölich:** Co-managing common pool resources: Do formal rules have to be adapted to traditional ecological norms?

2013-14 **Björn Vollan, Yexin Zhou, Andreas Landmann, Biliang Hu, Carsten Herrmann-Pillath:** Cooperation under democracy and authoritarian norms

2013-13 **Florian Lindner, Matthias Sutter:** Level-k reasoning and time pressure in the 11-20 money request game *forthcoming in Economics Letters*

2013-12 **Nadja Klein, Thomas Kneib, Stefan Lang:** Bayesian generalized additive models for location, scale and shape for zero-inflated and overdispersed count data

2013-11 **Thomas Stöckl:** Price efficiency and trading behavior in limit order markets with competing insiders *forthcoming in Experimental Economics*

2013-10 **Sebastian Prediger, Björn Vollan, Benedikt Herrmann:** Resource scarcity, spite and cooperation

2013-09 **Andreas Exenberger, Simon Hartmann:** How does institutional change coincide with changes in the quality of life? An exemplary case study

2013-08 **E. Glenn Dutcher, Loukas Balafoutas, Florian Lindner, Dmitry Ryvkin, Matthias Sutter:** Strive to be first or avoid being last: An experiment on relative performance incentives.

2013-07 **Daniela Glätzle-Rützler, Matthias Sutter, Achim Zeileis:** No myopic loss aversion in adolescents? An experimental note

2013-06 **Conrad Kobel, Engelbert Theurl:** Hospital specialisation within a DRG-Framework: The Austrian case

2013-05 **Martin Halla, Mario Lackner, Johann Scharler:** Does the welfare state destroy the family? Evidence from OECD member countries

2013-04 **Thomas Stöckl, Jürgen Huber, Michael Kirchler, Florian Lindner:** Hot hand belief and gambler's fallacy in teams: Evidence from investment experiments

2013-03 **Wolfgang Luhan, Johann Scharler:** Monetary policy, inflation illusion and the Taylor principle: An experimental study

2013-02 **Esther Blanco, Maria Claudia Lopez, James M. Walker:** Tensions between the resource damage and the private benefits of appropriation in the commons

2013-01 **Jakob W. Messner, Achim Zeileis, Jochen Broecker, Georg J. Mayr:** Improved probabilistic wind power forecasts with an inverse power curve transformation and censored regression

2012-27 **Achim Zeileis, Nikolaus Umlauf, Friedrich Leisch:** Flexible generation of e-learning exams in R: Moodle quizzes, OLAT assessments, and beyond

2012-26 **Francisco Campos-Ortiz, Louis Putterman, T.K. Ahn, Loukas Balafoutas, Mongoljin Batsaikhan, Matthias Sutter:** Security of property as a public good: Institutions, socio-political environment and experimental behavior in five countries

2012-25 **Esther Blanco, Maria Claudia Lopez, James M. Walker:** Appropriation in the commons: variations in the opportunity costs of conservation

2012-24 **Edgar C. Merkle, Jinyan Fan, Achim Zeileis:** Testing for measurement invariance with respect to an ordinal variable *forthcoming in Psychometrika*

2012-23 **Lukas Schrott, Martin Gächter, Engelbert Theurl:** Regional development in advanced countries: A within-country application of the Human Development Index for Austria

2012-22 **Glenn Dutcher, Krista Jabs Saral:** Does team telecommuting affect productivity? An experiment

2012-21 **Thomas Windberger, Jesus Crespo Cuaresma, Janette Walde:** Dirty floating and monetary independence in Central and Eastern Europe - The role of structural breaks

2012-20 **Martin Wagner, Achim Zeileis:** Heterogeneity of regional growth in the European Union

2012-19 **Natalia Montinari, Antonio Nicolo, Regine Oexl:** Mediocrity and induced reciprocity

2012-18 **Esther Blanco, Javier Lozano:** Evolutionary success and failure of wildlife conservancy programs

2012-17 **Ronald Peeters, Marc Vorsatz, Markus Walzl:** Beliefs and truth-telling: A laboratory experiment

2012-16 **Alexander Sebald, Markus Walzl:** Optimal contracts based on subjective evaluations and reciprocity

2012-15 **Alexander Sebald, Markus Walzl:** Subjective performance evaluations and reciprocity in principal-agent relations

2012-14 **Elisabeth Christen:** Time zones matter: The impact of distance and time zones on services trade

2012-13 **Elisabeth Christen, Joseph Francois, Bernard Hoekman:** CGE modeling of market access in services

2012-12 **Loukas Balafoutas, Nikos Nikiforakis:** Norm enforcement in the city: A natural field experiment *forthcoming in European Economic Review*

2012-11 **Dominik Erharter:** Credence goods markets, distributional preferences and the role of institutions

2012-10 **Nikolaus Umlauf, Daniel Adler, Thomas Kneib, Stefan Lang, Achim Zeileis:** Structured additive regression models: An R interface to BayesX

2012-09 **Achim Zeileis, Christoph Leitner, Kurt Hornik:** History repeating: Spain beats Germany in the EURO 2012 Final

2012-08 **Loukas Balafoutas, Glenn Dutcher, Florian Lindner, Dmitry Ryvkin:** The optimal allocation of prizes in tournaments of heterogeneous agents

2012-07 **Stefan Lang, Nikolaus Umlauf, Peter Wechselberger, Kenneth Harttgen, Thomas Kneib:** Multilevel structured additive regression

2012-06 **Elisabeth Waldmann, Thomas Kneib, Yu Ryan Yu, Stefan Lang:** Bayesian semiparametric additive quantile regression

2012-05 **Eric Mayer, Sebastian Rueth, Johann Scharler:** Government debt, inflation dynamics and the transmission of fiscal policy shocks *forthcoming in Economic Modelling*

2012-04 **Markus Leibrecht, Johann Scharler:** Government size and business cycle volatility; How important are credit constraints? *forthcoming in Economica*

2012-03 **Uwe Dulleck, David Johnston, Rudolf Kerschbamer, Matthias Sutter:** The good, the bad and the naive: Do fair prices signal good types or do they induce good behaviour?

2012-02 **Martin G. Kocher, Wolfgang J. Luhan, Matthias Sutter:** Testing a forgotten aspect of Akerlof's gift exchange hypothesis: Relational contracts with individual and uniform wages

2012-01 **Loukas Balafoutas, Florian Lindner, Matthias Sutter:** Sabotage in tournaments: Evidence from a natural experiment *published in Kyklos*

University of Innsbruck

Working Papers in Economics and Statistics

2013-31

Anita Gantner, Kristian Horn, Rudolf Kerschbamer

Fair division in unanimity bargaining with subjective claims

Abstract
In an experiment on a subjective claims problem we compare three unanimity bargaining procedures - the Demand, the Offer and the Exit variant - in terms of fairness and efficiency. To assess the fairness of the allocations obtained by these procedures, we evaluate them from a partial point of view using stakeholders' subjective evaluations of claims as elicited in a hypothetical fairness question, and we evaluate them from an impartial point of view using spectators' responses in a vignette. We find that after correcting for the self-serving bias in the partial view, both views point towards the same allocation. The Offer variant, which requires stakeholders to supply complete division proposals, yields outcomes that come closest to this fair allocation.

ISSN 1993-4378 (Print)
ISSN 1993-6885 (Online)