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Abstract

Alliances in the Shadow of Conflict

Changxia Ke, Kai A. Konrad and Florian Morath*

Victorious alliances often fight about the spoils of war. We consider experimentally when members of victorious alliances accept a peaceful division of the spoils, and when they fight against each other, and how the inability to commit to a peaceful division affects their effort contributions in their fight against a common enemy. First, we find that an asymmetric split of the prize induces a higher likelihood of internal fight and, in turn, reduces the effort contributions in the fight against a joint enemy. Second, non-binding declarations on how to divide the spoils in case of victory do not help to mitigate the hold-up problem.

Keywords: Conflict, contest, alliance, hold-up problem, experiment

JEL classification: D72, D74

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1 Introduction

Members of alliances who jointly defeated a common enemy often get into fight over the prize of victory. If they cannot agree on a peaceful division of the prize, they struggle about the division of it.[1] The economic value of what the alliance overall wins -net of these resource costs of internal struggle- is therefore less than the gross value of the prize. As a consequence, alliance members have lower incentives to contribute to the success of the alliance than in the case of a peaceful division of the prize.

The problem is well illustrated in the context of the Second World War.[2] During the end of the war, at the Yalta and Potsdam conferences, it became clear that right after victory of the Great Alliance against Nazi Germany, the alliance would be very likely to break up into at least two groups, one group led by the United States, and the other group led by the Soviet Union, and that they would start struggling about how to divide the planet between them. The struggle did not take the form of an actual war, but the Cold War was started, and lasted roughly forty years. An enormous amount of resources was dissipated in the arms race that started right after the defeat of Germany.

We study the structure that is underlying this problem in an experimental setting.[3] We are interested in the impact of possible future intra-alliance conflict on the alliance members' willingness to contribute effort to the alliance's fight against its enemy. More specifically we consider a two-stage setting in which the members of an alliance first fight jointly against a joint enemy. In

[1]For evidence from political history, see, e.g., Beilenson (1969), O' Connor (1969), or Bunselmeyer (1975).

[2]For a historical account, see, for instance, Weinberg (1994).

[3]Although in the experiment decisions are taken by individuals rather than countries or governments, the negociations at the Yalta and Potsdam conferences were heavily shaped by individual personalities, too. For instance, in Potsdam the heads of government used different entrances such that no one had to enter the venue behind or after someone else. Right at the beginning of the meeting, Stalin strategically proposed the chairmanship to Truman, presumably to impose on him the role of an intermediator.

case of a victory the alliance members can choose between a peaceful division of the prize between them and a fight between them about the prize. We ask: how does the possible internal fighting and its likelihood affect alliance players' willingness to contribute to the alliance effort in the fight against the outside player? In order to study this question in more detail, we consider several treatments that differ in the framework in which the alliance members make a choice about a peaceful division and fighting for the prize, which might generate different fighting probabilities.

The break-up of an alliance after victory is not always inevitable, and is, to a large extent, a matter of choice. For instance, whether the Great Alliance would break up right after a victory against Germany may have been less clear at the point when the United States entered into the war. Another example is the Hitler-Stalin alliance against Poland that led to the invasion into Poland and the division of Poland between Nazi Germany and the Soviet Union at the brink of the Second World War. The two alliance members kept peace between them for quite some time, but some time later Germany attacked the Soviet Union.[4] While alliances in military conflict boldly illustrate the problem, it is evident that the problem is relevant in contexts other than war. Alliances often occur in politics, when several parties or politicians team up in an effort to win an election or come into power by other means, and then have to decide whether or not to share power peacefully, or turn against each other. The Roman first triumvirate by Gnaeus Pompeius Magnus, Marcus Licinius Crassus and Gaius Julius Caesar and the second triumvirate by Marcus Antonius, Octavianus and Marcus Aemilius Lepidus are legendary historical examples. In both cases the members of the alliance turned against each other not long after jointly reaching power. Many examples can be found in other countries and historical episodes.[5] While in some cases the

[4]Stalin's concerns about the stability of the alliance between Russia and Germany in the months prior to 'operation Barbarossa' in June 1941, despite British warnings, are discussed by Reynolds (2002).

[5]Further examples can be found in Economics. For instance, in the theory of innovation,

internal fight and the alliance's fight against the common adversary may follow different rules, these examples highlight that former alliance members can decide on whether or not to enter into a quarrel with their former ally and that ex ante binding commitments are often impossible.

In our experimental setup we design the fight of the alliance with an outside adversary and the intra-alliance fight to be of very similar nature. We consider several variants of a base treatment which consists of three stages. In stage 1, an alliance of two players fights in a lottery contest against a stand-alone player about a fixed amount of money. If the stand-alone player wins, he gets the prize; if the alliance wins, each alliance player can choose between a peaceful and even split of the prize and an internal fight about the prize against the former ally (stage 2), where the latter would again take place as a lottery contest (stage 3). Each former member of the alliance can trigger this internal fight.

In a second treatment, we depart from this base scenario by requiring that the players have to divide the prize into a larger and a smaller share (70% vs. 30% of the prize value) if they share peacefully. Who would receive the larger share of the prize in case of peaceful division becomes known to the players only after the conflict between the alliance and the stand-alone player has been decided and the outcome was favorable for the alliance. This way fighting inside the alliance at stage 1 remains a symmetric game for the alliance members. Both in the base treatment and in this second treatment, the monetary payoff from sharing peacefully is higher than the expected monetary payoffs from fighting for the prize. Some alliance players, however, might still choose the fighting option due to more idiosyncratic reasons, and the asymmetric split of the prize should make the internal fight more likely. The comparison between the two treatments shows if and how the unequal division affects the probability of fighting, and how an increased

firms may team up and form a research venture in a patent contest, but then have to decide how to position themselves when marketing the product they have innovated jointly.

threat of internal conflict may induce the players to choose different amounts of contributions to the total alliance effort.

Two further treatments also modify the base treatment, keeping an egalitarian division within the alliance as the peaceful option. In these treatments, prior to choosing their contributions to the alliance effort (stage 1), the players make a declaration (in stage 0) about whether they intend to fight or share peacefully inside the alliance. In one of the treatments this declaration is made secretly to the operators of the experiment, but is not observed by the co-players. In the other treatment, the declaration becomes public information. In both treatments the players can later freely choose between the option to share peacefully or to fight. They have no monetary cost or disadvantages from not sticking to their declaration; their ex ante declaration is fully non-binding. The main questions addressed by these treatments is to see how the declarations (and their implications for the probability of a fight between former alliance members) affect the alliance members' willingness to contribute to the alliance effort, and what is the relationship between the individuals' declarations and their subsequent actual choices. One motivation for the consideration of non-binding declarations in this treatment is their empirical relevance in military or defence alliances. These are typically formed between sovereign players, and signing such agreements typically does not involve a binding and enforceable commitment. For this reason it is interesting to study whether such declarations may still yield some commitment in the experiment.

Major findings are: (1) Players are more likely to fight if the peaceful division suggests an uneven split. (2) The anticipation of a higher probability of future fighting inside the alliance comes together with lower contributions to the alliance effort. (3) The declarations about prospective decisions whether to fight or to share peacefully do not affect the players' choices in a significant way. A majority of players declares that they will not fight internally in the treatment in which this declaration is publicly observed, but those declarations do not lead to a lower fighting probability than in the base treatment.

This research is related to several strands of the literature. The Tullock (1980) lottery contest as a description of conflict has attracted considerable attention by experimental economists and psychologists. This research program confirmed that players generally expend more effort in the lottery contest than what would be expected from maximization of monetary payoffs. A small subset of this literature also considers experiments on group contests or collective action problems with contest elements.[6] These contributions do not consider the possibility of an independent, but subsequent intra-alliance contest and its impact on the alliance members' contributions to total alliance effort. Our main new findings are on endogenous break-up of coalitions, where alliance players choose endogenously about whether to fight among themselves or share peacefully.[7] We study the role of peaceful division rules and the role of alliance players' declarations in this context.

The formation and stability of alliances, the dynamics of this formation process over time, and the relation between alliances and conflict more generally has generated considerable interest in political science.[8] We focus on the endogenous decision about break-up of alliances that is followed by conflict between former alliance members. This break-up and its consequences is an important feature of alliances in the examples from the political sphere discussed, and it has attracted considerable attention in the political theory of alliances.[9] Empirically, as each single break-up or re-arrangement is typ-

[6]These include Parco, Amaldoss, and Rapoport (2005), Gunnthorsdottir and Rapoport (2006), Amegashie, Cadsby, and Song (2007), Abbink, Brandts, Herrmann, and Orzen (2010), Ahn, Isaac, and Salmon (2010),.Kugler, Rapoport, and Pazy (2010), and Sheremeta (2010).

[7]Ke et al. (2010) consider a related framework that includes a treatment in which members of a victorious alliance fight internally about this prize. However, in their framework the fighting is exogenously imposed and not a matter of choice.

[8]See Kimball (2006) and Johnson and Leeds (2011) for recent surveys and further empirical analyses.

[9]Formal model analysis on alliances include, for instance, Morrow (1991, 1994, 2000) and Niou and Ordeshook (1994). For rational choice explanations for why military fighting may take place see, e.g., Fearon (1995), Garfinkel and Skaperdas (2000) and Powell (2004).

ically imbedded into a unique larger historical and political framework, it difficult to test hypotheses about causal relationships. In laboratory experiments such events can be isolated from its historical context. This makes it possible to study causal relationships. However, the question has not been studied systematically using experiments. Morgan et al. (2010) were among the first to consider experiments on conflict with endogenous participation. In their framework more than two players could enter and fight, and whether entry caused an expected monetary payoff higher than the default payment depends on the number of entrants. The experimental work that is most closely related to our work is by McBride and Skaperdas (2009). They consider endogenous decisions of two players whether to fight with each other. They ask whether a longer or shorter time horizon of future possible conflict between two unrelated players leads to more or less conflict between these two players in an initial period. Their players have not been in an alliance and have no common history of fighting jointly like 'brothers in arms' against joint enemies. We consider players who have such a common history and could have developed some in-group favoritism or in-group spirit from fighting successfully in an alliance against an outside player. We look at their decision whether to fight or to share peacefully and analyze how the possible future conflict between them affects their collaborative efforts when they are fighting jointly in an alliance against an outside player.

From a theory perspective, our paper is closely related to several important areas in the theories of conflict. One strand of literature considers the role of negotiations or bargaining that occurs in "the shadow of conflict". Fighting is often the default of successful bargaining; the threat-point in the bargaining problem is a resource-wasteful fight between the negotiating players. For a survey on this issue see Fearon (1995). Further important contributions to this question are Skaperdas and Syropoulos (1996) and Anbarci, Skaperdas and Syropoulos (2002). Related to this, Slantchev (2003) formally models the role of possible fighting between two rivals as a determinant of how they interact and share resources in the future. A further set of results in the theory of conflict or contests has shown that the potential for future conflict among winners and many other situations generate hold-up problems in conflict, and discourage players from expending much effort in early rounds of dynamic contest situations. Examples for this outcome are Gradstein and Konrad (1999), Fu and Lu (2009), and Konrad and Kovenock (2009). A survey of the dynamics of contests is by Konrad (2009, Chapter 8), and illustrates the ubiquity of this discouragement effect of future conflict in dynamic situations. The analysis is also closely connected with the literature on intra- and inter-group conflict which has formally modelled the hold-up problem that emerges from a possible intra-group contest for the inter-group contest. This includes work by Katz and Tokadlidu (1996), Wärneryd (1998), Esteban and Sákovics (2003) and Konrad (2004).[10] In the Appendix we show how this work is modified by adopting the assumption that some players may have a non-monetary and transitory benefit or cost from participating in intra-alliance fighting, which may explain why and how much fighting may occur in the equilibrium.

The structure of the paper is as follows. In section 2 we describe the formal framework and the experimental setup. In section 3 we formulate the hypotheses that can be tested with this experiment. Section 4 outlines the major results. Section 5 concludes. An appendix provides a more formal description of the game theory framework that is the basis for the hypotheses in section 3.

[10] Another issue that received much controversy between economists and psychologists is the free-riding problem inside an alliance. The free-riding problem is pronounced in the economic literature, starting with the seminal paper by Olson and Zeckhauser (1966) and a large literature that emerged from this.

2 Theoretical and experimental framework

We consider a theoretical framework that builds on the alliance paradox analyzed by Esteban and Sákovics (2003), in which two alliance players are in a contest with a stand-alone player for a monetary prize. A formal and detailed description of the more general model framework and a theoretical analysis are in the Appendix. The experiment itself consists of one base treatment and three further treatments, each of which departs from this base treatment along one particular dimension.

The base treatment (BASE) is depicted in Figure 1. It is a game with three players and three stages. The players are denoted as A, B, and C. The two players A and B are considered as the members of an alliance. In stage 1 they jointly fight in a contest with a stand-alone player C about a prize, which has a monetary value of 450. The contest follows the rules of a standard Tullock (1980) lottery contest: all players choose independently and simultaneously an amount of effort $x_i \in \{0, 1, 2, ..., 250\}$, for $i \in \{A, B, C\}$. The cost of effort is normalized to be equal to the effort itself, and it cannot be recovered, regardless of whether or not a player wins the contest. The vector (x_A, x_B, x_C) of chosen efforts is publicly observed. Then, a random device determines whether the alliance AB or whether the stand-alone player C wins the prize. The probability for AB to win this prize in the lottery contest is equal to the share $p_{AB} = (x_A + x_B)/(x_A + x_B + x_C)$ if at least one of the effort components is strictly positive, and equal to 1/2 otherwise. The probability that C wins the prize is $p_C = 1 - p_{AB}$.

The subjects experience the probabilistic nature of the outcome, as they see a 'fortune wheel' on the computer screen. The fortune wheel is a disc that has two segments in different colors, where the size of the segments is proportional to the relative amounts of efforts $x_A + x_B$, and x_C, respectively. A pointer spins clockwise and then stops in one of the segments, and the prize is attributed to AB or to C, depending on the segment in which the pointer comes to a rest. Accordingly, the fortune wheel translates the true

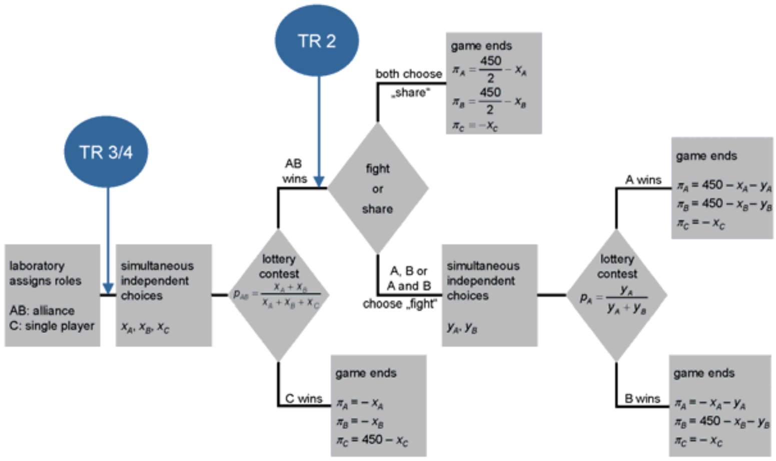

Figure 1: Sequence of actions in the BASE treatment.

win probability, which is a function of the efforts expended, into a graphical representation that makes it easy for the subjects to understand their win probability.

If C wins, the game ends, with monetary payoffs $\pi_C = 450 - x_C$, $\pi_A = -x_A$, and $\pi_B = -x_B$. If the alliance of players A and B wins, the prize is allocated between them in the following continuation game, consisting of two further stages. In stage 2, players A and B are asked to independently choose between an equal ($50 : 50$) split of the prize and a contest for the entire prize value. If both players choose the equal split, then the game ends. The payoffs in this case are $\pi_A = 450/2 - x_A$, $\pi_B = 450/2 - x_B$, and $\pi_C = -x_C$. If both players choose the contest, then the game enters into stage 3 for sure; if only one player chooses the contest, the game enters into stage 3 with a very high probability.[11] In stage 3, the two players A and B enter into a Tullock lottery contest. Each of them must choose an effort $y_i \in \{0, 1, 2, ..., 250\}$, for $i \in \{A, B\}$. The prize of 450 is allocated to A and B with probabilities $y_A/(y_A + y_B)$ and $y_B/(y_A + y_B)$, respectively, if at least one of these efforts is strictly positive, and with probabilities equal to 1/2 if both expend zero effort (i.e., if $y_A = y_B = 0$). Again, the random nature of the outcome is made transparent to the two players by way of a fortune wheel, with segments representing their respective shares in the two players' total contest effort. If the alliance wins in stage 1, the outcome of the choice of players A and B is a fight about the prize, and, say, player A wins the intra-alliance contest, the monetary payoffs are $\pi_A = 450 - x_A - y_A$, $\pi_B = -x_B - y_B$, and $\pi_C = -x_C$.

The markers in Figure 1 denoted TR2 and TR3/4 refer to modifications that become relevant in three further treatments to which we turn next. Treatment UNEQUAL is identical with the base treatment, with one change only: if the alliance AB wins in stage 1 and if A and B choose to share peacefully, rather than an equal split, one player receives 70 percent of the prize and the other player receives 30 percent. Which alliance player receives the larger share is determined randomly once the alliance wins the conflict with player C, but before the players have to decide whether they prefer the peaceful split, or whether they prefer a contest. In Figure 1 this additional decision node is indicated by the marker TR2 in the flow diagram, and the payoffs from peaceful sharing change accordingly from $450/2 - x_i$ for $i = A, B$ to $315 - x_i$ for the player with the 70 percent share and to $135 - x_i$ for the player with the 30 percent share. The continuation game in which

[11] To be precise, if both players choose to fight, then they enter into the symmetric contest in stage 3 with probability 1. If only one player chooses the equal split and the other player chooses to fight, fighting takes place with a probability of 90 percent, and a peaceful division occurs with a probability of 10 percent. This positive probability of peaceful sharing eliminates the (trivial) equilibrium in which both players choose "fight", simply because they expect the other player to choose "fight" and expect to have no influence on the outcome.

they fight is unchanged compared to the BASE treatment. Note that in stage 1 the game is symmetric for players A and B, and also the rules of the subgame in stage 3 treat both players fully symmetrically, should one or both of them choose to fight. Only at the point where they have to decide whether to accept the unequal split that is suggested, or whether to fight, they are treated asymmetrically.

In two further treatments we depart from the base treatment in another dimension. In treatment PRIVATE, players A and B make a declaration prior to stage 1, i.e., prior to the choices of efforts x_A, x_B, and x_C. This declaration is about whether an alliance player intends to fight or to choose the peaceful and symmetric distribution of the prize between A and B, should their alliance win against player C. This private declaration is not observed by other players and is non-binding (i.e., it can be reversed without direct cost later if the actual decision comes up). In Figure 1 an appropriate adjustment would be to add this declaration stage (stage 0) for players A and B right prior to their actual choices of stage 1 efforts (indicated by the marker TR3/4).

In treatment PUBLIC, players A and B make this declaration also prior to entering into stage 1. In contrast to the treatment PRIVATE, their statements immediately become public information, and this public nature of the declaration is known to the players. Also this declaration is not binding. Should the game reach the decision stage (stage 2), players A and B can make their actual choice about internal sharing or fighting fully independently from their previous declarations. While the PRIVATE treatment is mainly a control treatment, the PUBLIC treatment identifies the role of declarations for the effort contributions in stage 1.

Our analysis focuses on two comparisons. First, we compare the UNEQUAL treatment to the BASE treatment, in order to examine how a more unequal split in the peace-sharing solution changes the probability to fight internally, and may, hence, influence the alliance's contribution to external fighting effort against the stand-alone player. Second, we compare the treatments PRIVATE and PUBLIC to the BASE treatment to analyze whether the non-binding declaration in stage 0 might change the players' choices between fighting and sharing in stage 2 and whether the declaration might mitigate the hold-up problem in stage 1.

Before we turn to the equilibrium predictions and testable hypotheses, we briefly describe the institutional framework of the experiments. The experiment was programmed and conducted with the experiment software z-Tree (Fischbacher 2007) and carried out in the MELESSA laboratory at the University of Munich. The subjects were recruited from their subject pool and included students from all fields. The total number of subjects was 282. Each subject participated in 24 rounds of the same treatment and kept his individual role as alliance players or as stand-alone players throughout all rounds. Anonymity was preserved throughout the experiment between the subjects, and payments were made in private. During the experiments, students were divided into subgroups and rematched within these, in order to eliminate quasi-repeated games effects. The instructions were given to them and read to them by the laboratory staff, and in addition an entry quiz guided them through the experiment. Apart from a show-up fee of EUR 4, for each round played, they received a fixed payment of EUR 0.6, in order to reduce possible effects of good luck or bad luck in earlier, independent rounds. At the end of the experiment, subjects were paid according to their decisions and outcomes in 6 rounds randomly selected out of the 24 rounds played. Average earnings per subject were EUR 25 in total. Before ending the session, subjects were asked to answer an exit questionnaire. The time for a session was very similar across the treatments and roughly took 1.5 hours.

3 Equilibrium predictions

In the absence of a genuine pleasure for fighting internally or other behavioral factors, all four treatments have the same subgame-perfect equilibrium. Solving the game backwards, consider first stage 3. Should alliance players ever reach stage 3, their equilibrium efforts in this continuation game are $y_A = y_B = 112.5$, and each of them wins with the same probability of one half. This yields our first hypothesis:

Hypothesis 1: *The average efforts of former alliance players of a victorious alliance when fighting against each other are the same for all four treatments.*

Consider now stage 2. Should the alliance players jointly win against player C, the equilibrium prediction is not to fight, but to choose the peaceful sharing. The payoff from peaceful sharing is higher than the expected payoff from fighting. Note that this is true not only for the equal sharing rule, but also for both players in the asymmetric sharing rule (treatment UNEQUAL), as long as the smaller share exceeds $0.25 \times 450 = 112.5$.

Anticipating that players will not choose fighting in the equilibrium of the subgame that starts in stage 2, the equilibrium efforts in stage 1 are $(x_A + x_B)^* = 50$ and $x_C^* = 100$, yielding expected payoffs in the equilibrium that are equal to $(E\pi_A + E\pi_B)^* = 100$ and $(E\pi_C)^* = 200$.[12] Note that any non-binding declaration prior to stage 1 should not affect the subgame-perfect equilibrium of the continuation game beginning with stage 1. Hence, these effort choices are also the equilibrium predictions for the treatments with private and public declarations.[13]

[12] The conflict between the alliance and player C has multiple equilibria. While player C's effort is equal to 100 in all equilibria, only the alliance's total effort $x_A + x_B$ is uniquely determined.

[13] A deviation from what a player has promised to do may trigger emotions such as anger, disappointment etc. and may trigger actions that punish a player for his unkept promises, which can lead to alternative hypotheses and could explain differences between the BASE treatment and the treatments with declarations about the intention to fight.

As is known from experiments on contests, some players may have a benefit from participating in a contest or from winning it. This fighting mood may be constant or may alternate, which may cause more or less variability in the players' decisions about fighting over multiple independent situations. If such genuine preferences are taken into consideration, with the subjective benefit of fighting being a random variable that reflects temporary moods of players, this changes the equilibrium predictions. As these genuine preferences are private information, this turns the game into a game with incomplete and imperfect information. In the Appendix, we provide a formal description of this game and show that allowing for this type of fluctuating fighting moods may trigger that some alliance players A and/or B choose fighting in stage 2, causing a lottery contest in stage 3 instead of a peaceful settlement between the former alliance members. Moreover, we show in the Appendix that, under quite general conditions, the fighting outcome is more likely to emerge if the suggested peaceful distribution is more uneven. Hence, for the comparison between the BASE treatment and the UNEQUAL treatment, we expect to observe that more players choose fighting in the UNEQUAL treatment. These considerations are summarized in the following hypothesis.

Hypothesis 2: (i) *The share of players who choose the fighting option is lowest among players who would receive 70 percent of the prize if the alliance divided the prize peacefully, larger for players in case of an equal share, and highest for players who would receive only 30 percent of the prize. (ii) Overall, there is more fighting in the UNEQUAL treatment than in the BASE treatment***.**

The players who receive only 30 percent of the prize in case of a peaceful allocation do not have a monetary incentive to trigger internal fight. However, even in monetary terms, they are very close to indifference (which would hold for a 25 percent share). A small benefit from participation in the lottery contest is, hence, sufficient for them to trigger fighting.[14]

Suppose that players behave in accordance with Hypothesis 2. In this case, the subgame that emerges in the UNEQUAL treatment has a lower expected payoff (aggregated over the whole set of possible players) than the subgame that emerges from equal sharing (in the BASE treatment). This in turn suggests that, on average, alliance players should have stronger incentives to make the alliance win in the BASE treatment than in the UNEQUAL treatment; hence, they should expend more effort in stage 1 in the BASE treatment than in the UNEQUAL treatment. We summarize this consideration as a further testable hypothesis as follows:

Hypothesis 3: *In the conflict with player C, average effort of the alliance members is lower in the UNEQUAL treatment than in the BASE treatment.*

We now turn to the treatments in which players make declarations. For players who care about monetary payoffs only, the declarations in the treatments PRIVATE and PUBLIC should not affect subgame-perfect equilibrium play in the stages that follow, because the declarations are non-binding. There are, however, many possible channels through which the private and the public announcement could matter. In the context of theories about taste for consistency, self-perceptions about reliability and trustworthiness, a subjective cost of lying, and many other factors that are not directly related to monetary payoff, one could see a role for both private and public declarations. We will test the following hypothesis which is in line with the picture of self-centered, and mostly monetary-payoff oriented subjects.[15]

[14]Equity issues are also worth a consideration. Players A and B are in a fully symmetric situation prior to, and immediately after stage 1. Once they find out who would receive the smaller share in the peaceful division, they become unequal. They can restore an egalitarian situation by the decision to fight. But this fight generically leads to an outcome that is less egalitarian ex post, as one of them wins the whole prize and the other expends effort but wins nothing. Whether a choice in favor of fighting is made on the basis of redistributional preferences, is a very difficult matter, and the implications of possible other-regarding preferences are also not clear.

Hypothesis 4: *In the conflict with player C, average effort of the alliance members is the same in the treatments BASE, PRIVATE and PUBLIC.*

4 Results

Before we test the main Hypotheses $1-4$, Figure 2 gives a descriptive preview of the results on our main research question by showing average effort choices of alliance players (A or B) and stand-alone players in the inter-alliance conflict (stage 1). On average, stand-alone players expend around 150, and alliance players each expend around 75 or slightly less. Inspection of the descriptive data suggests that the contributions to alliance effort in the UNEQUAL treatment fall short of the contributions in the other treatments. This is in line with the consideration that the uneven split of the prize makes the hold-up problem more severe. The effort choices for players A and B in treatments BASE, PRIVATE and PUBLIC do not notably differ from each other.

Fighting after the break-up of the alliance Turning to a more systematic and detailed analysis of the division of the prize and effort in the fight between former alliance members, we first examine *Hypothesis 1* and consider whether history matters for average fighting effort if the former members of an alliance end up in fighting with each other. Individual effort of former alliance members in the internal fight is on average about 165 points, compared to an equilibrium value of 112.5 for players who maximize their monetary payoffs. As in most experiments on contests, players expend more effort than predicted by monetary payoff maximization. More importantly, investigating effort choices per treatment, there are basically no significant differences in intra-alliance efforts across treatments (compare the estimation

[15] Of course, this hypothesis is also in line with a mixture of other, mutually countervailing motives.

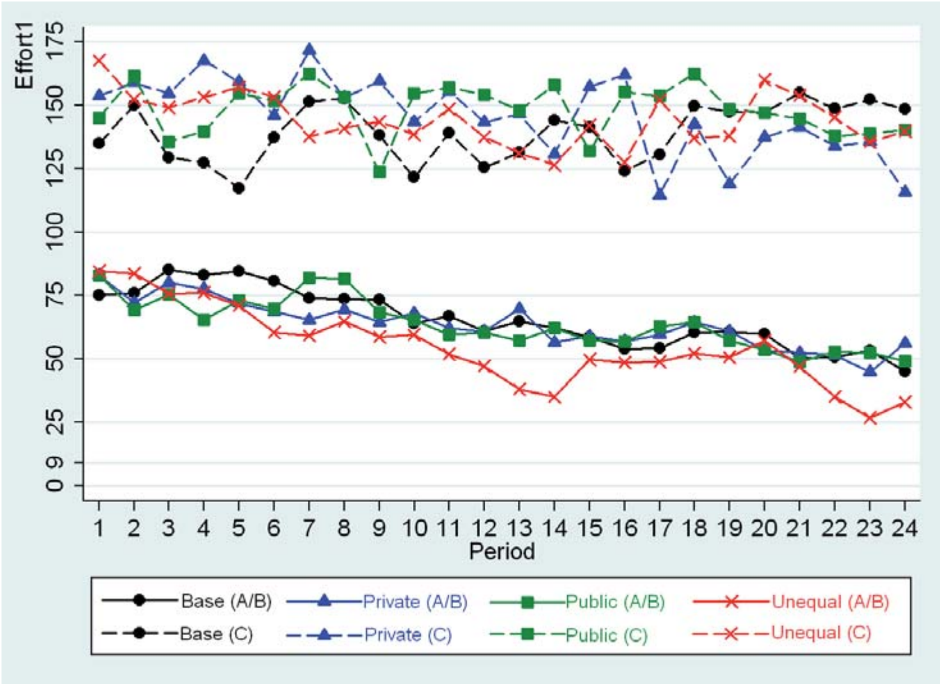

Figure 2: Average effort in the inter-alliance contest (stage 1).

results in Table 4 in the Appendix). Hence, the history (in terms of sharing rule or of declarations) does not matter for the average efforts expended if former alliance members end up in an internal fight. This result is important because it shows that the monetary payoff alliance players can expect from entering into an internal fight is the same across treatments.

Result 1: *Former alliance members of a victorious alliance fight heavily if they turn against each other; average efforts do not significantly differ across treatments.*

Probability of break-up and internal fight We next turn to *Hypothesis 2* and analyze the determinants of the likelihood of a victorious alliance to break up and fight. Consider the upper right part of Table 1 first. It presents actual choices of alliance players conditional on reaching stage 2. In line with *Hypothesis 2*, "fight" is chosen more frequently in the UNEQUAL treatment (32.6%) than in the BASE treatment (13.6%).[16] Also, the percentage of winning alliances ending up in internal fight in the UNEQUAL treatment is more than twice as high (54.5%) compared to that of the BASE treatment (24%).[17] This is in line with the theory results in the Appendix: the results emerge in equilibrium if there are players who would have gladly accepted peaceful equal sharing, but when left with a peaceful share of 30 percent, prefer fighting. They impose this fighting upon many players who, in the absence of fighting, would have obtained a 70 percent share and would have been satisfied with the sharing arrangement. Therefore, the actual fighting probability is, in most cases, the outcome of single players' decisions whether to fight. Overall this induces more fighting in the UNEQUAL treatment, compared to the treatment with an equal division of the prize.

Before we turn to a more quantitative assessment of this difference, we also consider the descriptive statistics of fighting probabilities for the treatments with declarations. The lower left part of Table 1 reports summary statistics of the alliance players' ex ante declarations in stage 0 about the prize sharing intention; the share of players indicating to prefer "share" is 80.9% in the PRIVATE treatment and 88.9% in the PUBLIC treatment. This difference in declaration choices contrasts with very small differences in actual fighting frequency between the BASE treatment and the two treatments with public or private declarations.

To explore more quantitatively what influences the alliance players' like-

[16]Note that, in the experimental instructions, we did not use the word "fight". Instead, participants were asked to choose between an equal split of the prize and competing with their co-player about the entire prize value. Yet we will use the words "fight" and "share" for simplicity whenever we talk about this decision.

[17]Recall that each player can induce the fight by his choice of "fight" with a probability of 0.9 even if the other player chooses "share", and the probability of fighting in stage 3 is 1 if both players choose "fight".

Treatment	No. of obs. in stage 0	Ex ante declaration "share"	"fight"	No. of obs. in stage 2	Actual binding decision "share"	"fight"	% internal fight if AB wins
BASE	1152	N/A	N/A	550	86.4%	13.6%	24.0%
UNEQUAL	1056	N/A	N/A	448	67.4%	32.6%	54.5%
PRIVATE	1152	80.9%	19.1%	560	83.2%	16.8%	27.5%
PUBLIC	1152	88.9%	11.1%	528	85.6%	14.4%	25.4%

Table 1: Alliances' decision on prize sharing rule before and after the inter-alliance contest.

lihood to choose fight, we report both OLS and random-effects logistic regressions in Table 2. The dependent variable is an alliance player's binary choice on whether to fight or not against the former ally in case of a victory against player C; "1" indicates the choice of a contest and "0" the choice of a peaceful split. The reference category is the BASE treatment.

In line with *Hypothesis 2,* a significant share of players chooses to fight rather than the peaceful split of the alliance prize. Subjects are 15 percentage points more likely to choose "fight" in the UNEQUAL treatment than in the BASE treatment (see "UNEQUAL" in OLS1).[18] Separating the subjects in the UNEQUAL treatment according to the peaceful share they would receive, those who would get the share of 70% are 6 percentage points *less* likely to choose fight than those in the BASE treatment (now measured by "UNEQUAL" in OLS2); the estimated coefficient is significantly different from zero at the 5%-level in the random effects logit estimation (xtlogit2). The subjects with the smaller share (30%), however, are 43 percentage points *more* likely to choose fight than those with the larger share (measured by the variable "UNEQUAL×30%") and therefore 37 percentage points more likely to choose fight than the subjects in the BASE treatment. Hence, individual choices about the conflictual break-up of their alliance react to the peaceful

[18] We discuss the marginal effects using coefficients from OLS model becasue it is simple and comprehensible. Average marginal effects calculated from the the random effects logit model do not differ significantly from these coefficients.

Dependent Variable: Alliance player's probability to choose fight in stage 2 conditional on winning in stage 1 (periods 13-24)				
Independent Variables:	OLS1	OLS2	xtLogit1	xtLogit2
Constant	0.12***	0.12***	-2.84***	-3.00***
	(0.03)	(0.02)	(0.41)	(0.41)
UNEQUAL	0.15***	-0.06	1.44***	-1.74**
	(0.05)	(0.04)	(0.52)	(0.78)
UNEQUAL×30%		0.43***		4.81***
		(0.07)		(0.79)
PRIVATE	-0.01	-0.08**	-0.30	-1.72**
	(0.04)	(0.03)	(0.54)	(0.68)
PRIVATE×Fight0		0.37***		3.57***
		(0.06)		(0.82)
PUBLIC	0.01	-0.00	0.16	-0.00
	(0.04)	(0.04)	(0.53)	(0.52)
PUBLIC×Fight0		0.34**		1.79*
		(0.15)		(0.99)
PUBLIC×Fight0_partner		0.05		1.76
		(0.13)		(1.16)
Effort1_diff		0.001***		0.02***
		(0.00)		(0.002)

Note: 184 subjects, 940 observations. Standard errors in brackets (in OLS, clustered at individual level). ***(**,*) significant at 1%(5%,10%). The estimations include treatments dummies as well as interactions indicating the player with the small share ("30%" in UNEQUAL), the declaration on the fighting intention ("Fight0" in PRIVATE and PUBLIC; "Fight0_partner" in PUBLIC), and the difference between own and alliance partner's stage 1 effort ("Effort1_diff"). Reference category is the BASE treatment.

Table 2: Winning alliances' probability to choose internal fight.

share they would obtain, in line with Hypothesis 2. Overall, this leads to a higher fighting intensity in the UNEQUAL treatment.

The PRIVATE and the PUBLIC treatment do not significantly differ from the BASE treatment in terms of individual choices about the prize-sharing. In other words, the opportunity of making private or public announcements does not noticeably affect the probability that a victorious alliance breaks up and ends up in an intra-alliance fight. Taking into account the impact of private and public declarations (variable "Fight0"[19]), in the PRIVATE treatment alliance players who have declared that they intend to choose "fight" are 37 percentage points more likely to actually initiate a fight in stage 2 than those who prefer to "share" (compare PRIVATE×Fight0 in OLS2). This suggests that private declarations are not random, but reveal true intentions, for instance, because of a preference for own consistent behavior. In the PUBLIC treatment, a player is more likely to initiate internal fight if he or his former alliance partner declared an intention to choose "fight" in stage 0 (see coefficients for "PUBLIC×Fight0" and "PUBLIC×Fight0_partner"). The significance level of the coefficients, however, is much weaker than in the PRIVATE treatment. The declarations in the PUBLIC treatment may not fully reveal alliance players' true preference, but players may choose a declaration which they expect to have a strategic effect on the co-players' behavior. Correspondingly, alliance players choose "share" more often (88.9%) if this announcement is revealed to all other players they interact with than if it is kept secretly (80.9%, compare Table 1). This can explain why the public declaration on the intention to choose "fight" or "share" need not be a good predictor of players' true intention to fight, nor for their contribution to the fight against a member outside the group (as we will examine in the next section).

In addition to the variables discussed, the difference between own effort and partner's effort in contribution to the inter-alliance contest (*Effort1_diff*) has a strongly significant impact on the likelihood to fight (0.1 percentage points per 1 unit of contribution gap): the more a player expended in stage 1 relative to his alliance partner, the higher is the likelihood that he triggers internal fight.

[19] "Fight0" is a dummy variable that is equal to one if and only if the respective player has declared in stage 0 an intention to fight internally.

Result 2: *The individual probability of choosing fight is highest among players who would get the small share (30%) in the UNEQUAL treatment and lowest among those who would get the large share (70%) in the UNEQUAL treatment. Overall, there is a higher probability for an internal fight in the UNEQUAL treatment than in the three other treatments.*

Effort in the conflict with the stand-alone player We now turn to our main analysis: the anticipation of the fighting intensity and the resulting hold-up problem (*Hypotheses 3* and *4*). The hypothesis about different effort contribution levels between the BASE and the UNEQUAL treatment is motivated by differences in the values attributed to the continuation game from stage 2 for the two treatments. Whether the equal-split rule or the uneven rule is more attractive to the players cannot be compared directly. However, since in the UNEQUAL treatment the option "fight" is chosen in stage 2 more often than in the BASE treatment, this suggests that overall the peaceful split is less attractive in the UNEQUAL treatment. Fighting between victorious alliance members becomes much more likely when the suggested distribution between them is asymmetric (see Table 1). Recall that the higher frequency of choices of "fight" is not driven by differences in fighting behavior in stage 3 for the two treatments (see Table 4 in the Appendix for the estimation results on stage 3 effort).

The regression results for alliance players' effort in stage 1 are shown in Table 3. The dependent variable is the effort expended by each player in the fight against the out-group player, and we estimate both OLS and tobit models.[20] Consider first the impact of an increased fighting intensity as in the UNEQUAL treatment. Consistent with the average effort time series

[20] By using a tobit specification, we take into consideration that effort choices are restricted between 0 and 250 and that in all treatments a number of choices lie on the boundary. Also, the estimation accounts for heterogeneity across players and high correlations within each individual players, by adding random effects to the tobit model. We report results using data from periods 13 to 24, i.e., we consider more experienced play. Using the full dataset does not yield qualitatively different results.

Dependent Variable: alliance player's effort in stage 1 (periods 13-24)				
Independent variables:	OLS1	OLS2	xtTobit1	xtTobit2
Constant	56.16***	56.16***	54.10***	54.13***
	(4.83)	(4.84)	(5.43)	(5.36)
UNEQUAL	-12.67*	-12.67*	-17.06**	-17.00**
	(7.17)	(7.17)	(7.88)	(7.78)
PRIVATE	0.93	-4.18	-0.59	-7.13
	(6.75)	(6.89)	(7.68)	(7.67)
PRIVATE×Fight0		31.31**		39.78***
		(12.33)		(6.87)
PUBLIC	0.08	3.32	-0.84	0.80
	(6.45)	(6.61)	(7.68)	(7.64)
PUBLIC×Fight0		-5.61		10.63
		(9.63)		(7.74)
PUBLIC×Fight0_partner		-30.95***		-30.55***
		(7.72)		(6.73)

Note: 188 subjects, 2256 observations. There are 281 left-censored obs., 1961 uncensored obs., 14 right-censored obs. in tobit models. Standard errors in brackets (in OLS, clustered at individual level). ***(**,*) significant at 1%(5%,10%). The estimations include treatments dummies as well as interactions indicating the declaration on the fighting intention ("Fight0" in PRIVATE and PUBLIC; "Fight0_partner" in PUBLIC). Reference category is the BASE treatment.

Table 3: Alliance players' effort in the inter-alliance contest (stage 1).

shown in Figure 2 we find that average effort in the UNEQUAL treatment is by 17 points lower than average effort expended in the BASE treatment; the difference is statistically significant. This result is in line with the main *Hypothesis 3*.

Result 3: *Anticipation of the higher internal fighting intensity in the UNEQUAL treatment leads to lower stage 1 effort of the alliance members, compared to the BASE treatment.*

We now turn to the effects of private and public announcements. In line with *Hypothesis 4*, coefficients on treatment dummies *PRIVATE* and *PUBLIC* are both not significant in the estimation, which suggests that there is no treatment effect of adopting a stage 0 with private or public declarations. The estimation which takes into account the role of the non-binding declarations shows first of all that in the PRIVATE treatment alliance players who have secretly declared that they intend to choose "fight" expend significantly more (around 40 points) than those who have indicated that "share" is preferred. This suggests that the players may differ in their "joy of fighting" and state their preference truthfully. Second, in the PUBLIC treatment, alliance players who have declared that they intend to choose "fight" do not expend significantly more effort (although the estimated coefficient is positive). Third, if in the PUBLIC treatment the partner in the alliance has declared that he/she intends to fight ("Fight0_partner"), a player expends much less effort (the coefficient is -30.55 and highly significant). Even though declarations are non-binding[21], players may take this declaration quite seriously.[22]

Result 4: *Declarations of the prize-sharing intention in the PRIVATE and PUBLIC treatment do not affect alliance players' effort choices in stage 1, compared to the BASE treatment.*

The treatment effects for alliance players could also have a strategic effect on player *C*'s effort choice when stand-alone players anticipate a change in

[21]If players differ in their cost of making a false or inconsistent declaration, and if the cost is strictly positive, then the set of players who declare "share" is a mixture of people who eventually choose "share" and who eventually choose "fight". But only those who eventually choose "fight" and have a high cost of declaring "share" under these circumstances will declare "fight". Accordingly, a declaration of "fight" is revealing in such a context.

[22]Controlling for individual characteristics does not change the results; the only significant variable is gender: females in alliances on average expend 14.3 points more than male players (p-value<0.001). This finding is in line with results in a number of auction and contest experiments (Chen et al., 2009; Ham and Kagel, 2006; Casari et al., 2007; Charness and Levin, 2009; Sheremeta, 2011).

alliance players' effort contributions and react to this change by adapting their own effort choice. As the summary statistics in Figure 2 have already suggested, however, such strategic reactions turn out to be very small and statistically insignificant for the different treatments (see the regression results on player C in Table 5 in the Appendix). In summary, our results provide supporting evidence for the major hypotheses derived in the previous section.

5 Conclusions

Members of a victorious alliance may decide to share the prize of winning peacefully, or they may decide to enter into a fight about the spoils of victory. Whether or not they fight may depend on the institutional setup and existing norms and rules about how to split the prize if the division of the prize takes place peacefully. While many factors may play a role in the historical examples discussed in the introduction, the possible sharing rules in case of peaceful division are potentially important factors that may yield different probabilities of an internal fight within the alliance. We study experimentally how these different levels of threat of internal conflict affect the alliance members' willingness to contribute to the fight against an outside stand-alone player. We find that these differences lead to variations in contributions to alliance effort that are qualitatively in line with the equilibrium predictions of the alliance game between selfish players, with possible non-monetary benefits from fighting or winning. In particular, players are more likely to fight internally the more unequal is the division of the prize. As a main result, players contribute less effort to the contest against the stand-alone player if the probability of a break-up of the alliance with future internal fighting about the prize is higher.

As a second dimension, we study the role of declarations at the onset of the conflict between the alliance and its adversary: alliance players may make non-binding private or public declarations at this point about their intentions whether to fight internally or to share peacefully with their alliance partner. We ask whether these declarations affect the actual fighting probability and the effort contribution to the contest against the outside player. In line with the hypothesis derived from standard theory, the declarations neither change the actual probability to fight nor the effort contributions of alliance players in the conflict with the outside player in a significant way, compared to the base design where declarations of this type are not possible. Even if alliance players may use a public declaration about their future choices about whether to fight or share the prize peacefully with the former ally, this declaration does not help to mitigate the hold-up problem: it does not reduce actual fighting inside victorious alliances.

To summarize, alliances are more likely to dissolve in quarrels over the spoils of victory if they are more asymmetric in terms of effort contributions in the conflict with the outside enemy and in terms of the shares of the prize they would receive in case of a peaceful split. In turn, more "symmetric" alliances are more successful in keeping internal peace and, as a direct effect, they are more successful in the conflict with the common adversary. Hence, declaring early on an intention to keep peace does not effectively improve alliance success in the experiment. Instead, in our context, similarity between players with respect to their entitlement to the prize and to their willingness to expend effort seems to be more promising for the formation of alliances in the shadow of conflict.

A Appendix

A.1 Extended theoretical framework

This appendix describes the full theoretical framework that essentially maps the alliance paradox considered by Esteban and Sákovics (2003), but includes incomplete information about a contestant's possible desire to fight in a lottery contest. It derives Hypothesis 2 formulated and tested in the main text of the paper.

Consider the following setup based on the game described in Section 2. An alliance consisting of two contestants, A and B, plays a lottery contest against a single player C. If player C wins, the game ends. If the alliance wins, the alliance members must allocate the prize among themselves. The rules of this process are as follows. First, a lottery takes place which assigns the roles as $S(trong)$ and $W(eak)$ to the players A and B, where the probability for being assigned the role S is the same for both players and equal to $1/2$. Simultaneously with the outcome of this lottery they also learn their own intrinsic attitude towards fighting. Each player $i \in \{A, B\}$ may have an additional immaterial benefit (or cost) from playing a further lottery contest with his former ally, and the monetary equivalent of entering into such a fight is denoted as z_i.[23]

Once the two players know their roles (S or W, respectively), they have to decide whether the prize is awarded peacefully between them, or whether they fight about the allocation of the prize. If both players choose the peaceful allocation rule, then the prize is divided between them such that the player who is assigned the role S gets a share of $q \geq 1/2$ of the prize value v ($v = 450$ in the experimental setup), and the player W gets a share of $1 - q \leq 1/2$. If at least one player chooses the conflictual allocation of the prize, then they enter into a subgame which is described by a simple symmetric Tullock lottery contest between the two.

The payoffs are characterized as follows. Players like winning the prize and all players assign the same value to the prize, equal to v. Also, all

[23] Alternatively, players may know their intrinsic benefit of fighting at the very beginning of the game, and already when they choose their alliance efforts. However, as the results in the experiment show, the intrinsic benefit of fighting seems to be volatile across rounds for the same player. Moreover, if the intrinsic benefit were known to the players already when making their contest efforts within the alliance, this would drastically change the nature of the overall game, as the contest effort x_i in the contest between the alliance and player C conveys information about players' types.

players dislike effort, or rather the cost of expending this effort. Further, players may have a joy of participating in a contest (as has been argued for and measured in an experiment by Sheremeta 2010). This joy may exist, but does not very much matter in most contest games, as the game itself is exogenously staged. However, this joy (or discomfort) would clearly matter when players endogenously choose whether to enter into a contest or not. If they have an immaterial benefit from participating in a lottery contest, this will increase their inclination for entering into such a contest. In order to describe this joy of contesting, we assume that all players have a joy of fighting that is described by a monetary equivalent equal to $z \in \mathbb{R}$. This z may differ between different players, and we assume that, for each player, his z is independently drawn from a continuous distribution function with cumulative probability $F(z)$. We also assume that each player knows his own z but does not know the z of the co-players, and knows only the cumulative distribution of z from which these are drawn.

Consider first the lottery contest that emerges if the alliance players have defeated the outside player and have decided to fight about the intra-alliance distribution of the prize. This game has a standard solution (Tullock 1980). It yields $y_S = y_W = v/4$ as the equilibrium effort levels and expected monetary payoffs for each of the two players equal to $v/4$. In addition, they earn their respective immaterial joy of contesting, denoted z_S and z_W, respectively. Hence, at the stage at which the alliance won the prize and alliance players are assigned their roles, player S prefers the peaceful outcome if

$$qv \geq z_S + \frac{v}{4} \tag{1}$$

and prefers to fight otherwise. (In case of equality, we assume that the player opts for the peaceful outcome.) Similarly, the player W prefers the peaceful allocation if and only if

$$(1-q)v \geq z_W + \frac{v}{4}. \tag{2}$$

Accordingly, the players allocate the prize peacefully between them with a probability

$$F(qv - \frac{v}{4})F((1-q)v - \frac{v}{4}). \quad (3)$$

They fight with the complementary probability. In the latter case, each player has the same expected material payoff from the subgame equal to $v/4$, plus the monetary equivalent z_S and z_W from his joy of fighting. Recall that the roles S and W are randomly assigned to the members of the winning alliance with equal probabilities. We can, therefore, calculate the expected payoff of a player with a joy of fighting of z_i from reaching the stage in which the alliance wins against the stand-alone player C.

With probability $1/2$ a player i enters into the intra-alliance continuation game as a strong player S. If $z_W > (1-q)\,v - v/4$, then the weak player prefers to fight and the players enter into the internal contest. Otherwise, the weak player prefers peace and therefore fighting takes place if and only if $z_S > qv - v/4$. If players fight, then S gets a payoff of $z_S + v/4$. Overall, expected payoff of the strong player S in the continuation game is equal to

$$\begin{aligned} E\left(\pi_S\right) &= F\left((1-q)v - \frac{v}{4}\right) \int_z \max\left\{qv, z + \frac{v}{4}\right\} dF\left(z\right) \\ &\quad + \left(1 - F\left((1-q)v - \frac{v}{4}\right)\right)\left(E\left(z\right) + \frac{v}{4}\right). \end{aligned}$$

Similarly, in the continuation game the weak player W gets an expected payoff of

$$\begin{aligned} E\left(\pi_W\right) &= F\left(qv - \frac{v}{4}\right) \int_z \max\left\{\left(1-q\right)v, z + \frac{v}{4}\right\} dF\left(z\right) \\ &\quad + \left(1 - F\left(qv - \frac{v}{4}\right)\right)\left(E\left(z\right) + \frac{v}{4}\right). \end{aligned}$$

Moving back further, the expected payoff of a player whose alliance won, but who still does not know his immaterial payoff z_i, and who has not learned whether he will be in the role of the strong or the weak player has an expected payoff of

$$\Pi_{AB} = \frac{1}{2}E\left(\pi_S\right) + \frac{1}{2}E\left(\pi_W\right). \tag{4}$$

Depending on the distribution of z_i, Π_{AB} can be considerably larger than $v/2$, but it can also be smaller than $v/2$, with $v/4$ being a lower bound if z_i cannot have negative values. Π_{AB} is the value that enters as the value of the prize of winning for each of the players A and B in the inter-alliance conflict against player C; it determines their and player C's equilibrium effort choices in the inter-alliance contest. Note, in particular, that the information structure on the assignment of the roles S and W and on the immaterial benefit of fighting makes the stage 1 contest a contest under incomplete but perfect information. The general solution of the stage 1 equilibrium is characterized by values

$$(x_A + x_B)^* = \frac{\Pi_{AB}^2 v}{(\Pi_{AB} + v)^2}$$

$$x_C = \frac{\Pi_{AB} v^2}{(\Pi_{AB} + v)^2}$$

Our main emphasis is on the role of the size of q, that is the asymmetry generated by associating former alliance players the roles of being the strong or the weak player. An increase in q starting from $q = 1 - q = 1/2$ makes conflict in the continuation game among alliance members more likely. To see this, consider the impact of q on the probability of a decision to enter into a fight, and on actual fighting.

Proposition 1 *(i) The probability that the strong (weak) player prefers fighting is decreasing (increasing) in q.*
(ii) If the ratio F'/F is decreasing, then the probability that at least one of the players prefers fighting is increasing in q.
(iii) If $z_{\max} \leq v/4$, then fighting is (weakly) more likely for $q > 1/2$ than for $q = 1/2$.

Proof. Part (i) follows directly from the indifference conditions (1) and (2). For (ii), note that peaceful settlement occurs if both former alliance members refrain from fighting. This happens with the probability $F((1-q)-\frac{v}{4})F(q-\frac{v}{4})$. Consider the change in the probability of peaceful settlement due to an increase in q. This probability is decreasing (and the complementary probability of conflict is increasing in q) if $-vF'((1-q)-\frac{v}{4})F(q-\frac{v}{4})+F((1-q)-\frac{v}{4})F'(q-\frac{v}{4})v<0$, or

$$\frac{F'(q-\frac{v}{4})}{F(q-\frac{v}{4})}<\frac{F'((1-q)-\frac{v}{4})}{F((1-q)-\frac{v}{4})} \tag{5}$$

This condition is fulfilled for all distributions F where F'/F is decreasing. Evidently, $F(q-\frac{v}{4})\geq F((1-q)-\frac{v}{4})$ by the assumption that $q\geq 1/2$, making the denominator on the left-hand side larger than the denominator of the right-hand side for discrete increases in q. For (iii), note that conditions (1) and (2) always hold if $q=1/2$ and the support of the distribution of z_i is sufficiently constrained from above (by $z_i\leq v/4$), which is the condition suggesting that the joy of conflict is essentially smaller than what is materially on stake in the contest. Increasing q may then violate (2) for some realizations of z_i and thus make fighting (weakly) more likely. ■

The first part of the proposition shows that the smaller a player's share in the prize in case of a peaceful split, the higher is the probability that this player chooses to fight (compare *Hypothesis 2(i)*). The second and the third part of the proposition state sufficient conditions such that overall there is more fighting if the peaceful split of the prize becomes more unequal (*Hypothesis 2(ii)*).

A.2 Additional estimation results

Dependent Variable: alliance player's effort in stage 3 (periods 13-24)				
Independent variables:	OLS1	OLS2	xtTobit1	xtTobit2
Constant	152.89***	126.52***	172.02***	175.53***
	(14.01)	(27.61)	(16.56)	(30.46)
UNEQUAL	15.44	8.12	7.58	4.44
	(17.28)	(20.14)	(21.54)	(22.09)
UNEQUAL×30%		6.24		5.30
		(16.86)		(16.71)
PRIVATE	32.66*	14.38	17.94	-9.15
	(18.17)	(23.00)	(24.55)	(27.97)
PRIVATE×Fight0		18.90		51.53
		(19.71)		(34.51)
PUBLIC	7.89	7.70	-2.12	-2.72
	(17.40)	(17.39)	(22.80)	(22.59)
PUBLIC×Fight0		-1.56		13.64
		(15.96)		(37.64)
PUBLIC×Fight0_partner		67.06**		57.40
		(16.00)		(35.92)
Effort1_diff_abs		0.29***		0.33***
		(0.08)		(0.08)
Fight2		17.71		-25.26
		(26.28)		(27.02)
Fight2_partner		-1.12		-25.74
		(23.99)		(26.00)

Note: 120 subjects, 256 observations. 4 left-censored obs., 194 uncensored obs., 58 right-censored obs. in tobit models. Standard errors in brackets (in OLS, clustered at individual level). ***(**,*) significant at 1%(5%,10%). The estimations include treatments dummies as well as interactions indicating the player with the small share ("30%" in UNEQUAL), the declaration on the fighting intention ("Fight0" in PRIVATE and PUBLIC; "Fight0_partner" in PUBLIC), actual fighting decisions in stage 2 ("Fight2", "Fight2_partner"), and the absolute difference between own and alliance partner's stage 1 effort ("Effort1_diff_abs"). Reference category is the BASE treatment.

Table 4: Alliance players' effort in the intra-alliance contest (stage 3).

Dependent Variable: player C's effort in stage 1 (periods 13-24)				
	OLS1	OLS2	xtTobit1	xtTobit2
Constant	143.39***	143.39***	148.23***	148.23***
	(12.76)	(12.76)	(16.02)	(16.02)
UNEQUAL	-2.72	-2.72	5.49	5.50
	(18.66)	(18.67)	(23.25)	(23.25)
PRIVATE	-6.96	-6.96	-3.22	-3.22
	(17.43)	(17.44)	(22.72)	(22.72)
PUBLIC	3.84	3.78	10.03	10.10
	(16.93)	(17.41)	(22.73)	(22.79)
PUBLIC×Fight0_alliance		0.42		-0.43
		(12.20)		(10.28)

Note: 94 subjects, 1128 observations. 21 left-censored obs., 935 uncensored obs., 172 right-censored obs. in tobit models. Standard errors in brackets (in OLS, clustered at individual level). *** significant at 1%. The estimations include treatments dummies (UNEQUAL, PRIVATE and PUBLIC) and, for the PUBLIC treatment, an interaction indicating whether at least one alliance player declared an intention to fight ("Fight0_alliance"). Reference category is the BASE treatment.

Table 5: Player C's effort in the inter-alliance contest (stage 1).

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