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# Research Report

## Unity Is Strength: An Experimental Study of Decentralized and Collective Bargaining

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# UNITY IS STRENGTH:
# AN EXPERIMENTAL STUDY OF DECENTRALIZED AND COLLECTIVE BARGAINING *

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**Abstract**

We present an experiment where two players bargain with a third player. They can bargain either separately or form a joint venture to bargain collectively. Our theoretical benchmark solution predicts decentralized bargaining, as only one player has an interest in forming a joint venture. However, we observe a significant amount of collective bargaining. Collective bargaining, when compared with decentralized bargaining, has no significant effect on the payoffs of the merged partners but reduces the payoff of the third player.

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## 1. Introduction

One of the most basic decisions in human life is on whether to cooperate with others or to rely on one’s own efforts only. An extreme form of cooperation is the foundation of a *joint venture* or, in other words, the replacement of individual efforts by a common endeavor. We find such extreme forms of cooperation as merger in industry, trade unions, political parties, and many other social groups.

By our experiment we examine subjects' behavior in a situation where they may either opt for a joint venture and bargain collectively or bargain individually with a third party. Initiating and organizing a joint venture usually includes many different aspects. The parties involved have, for example, to decide on who does what. This is an aspect that we neglect in our experiment. We focus on the subjects' decisions for or against forming a joint venture and on their bargaining strategies with and without the joint venture. The specific purpose of the joint venture is to bargain with a third party on a contract.

In a previous study (Berninghaus et al., 1998) a simple model of this joint venture problem is introduced and both theoretically and experimentally investigated. There are two major results. First, the theoretical solution predicts collective bargaining for some parameter combinations (with respect to conflict payoffs), while it predicts decentralized bargaining for others. The experimental data, however, do not reveal the predicted tendencies. Second, due to a basic asymmetry, one of the potentially merging parties is stronger than the other. In some situations it is better for the stronger party to vote against collective bargaining, while for the weaker party it is always better to vote for collective bargaining. This finds expression in the experimental data in that the weaker party votes for centralization more often than the stronger party.

The model of Berninghaus et al. (1998) allows for only two possible contracts. This is a highly restrictive assumption, which we abandon in the present experiments where many contracts are possible. Furthermore, in order to obtain a richer data set, we apply the strategy method of experimentation. We simultaneously ask all subjects to give entire strategies for playing the game. A strategy prescribes the bargaining decisions for both the case of collective and the case of decentralized bargaining in addition to the decision for or against forming the joint venture (by its potential partners).

The potentially merging parties could represent trade union representatives who decide on whether they bargain collectively or individually on wages with the employers' representative. The industrialized countries show large differences in wage bargaining structures. Wage bargaining can take place at several different levels. At the extreme case of decentralization (as, for example, in the United States and Canada), firms and employees negotiate over wages and working conditions at the level of the individual establishment. At the other extreme of centralized bargaining (as, for example, in the Scandinavian countries), national unions and employers' associations may bargain for the whole country. At the intermediate level (as, for example, in Belgium, Germany, and the Netherlands), we may find sectoral, branch, or industry-level bargaining.

In the macroeconometric literature there is an on-going debate about the impact of the degree of centralization in wage bargaining on macroeconomic performance and, in particular, the wage rates in a country (see OECD, 1997, for a survey). Calmfors and Driffill (1988) argue that there is a hump-shaped relationship. On theoretical and empirical grounds, they come to the conclusion that both complete decentralization and complete centralization yield lower wage rates than intermediate situations. But their result could not be replicated by, for example, Fitzenberger (1995). Up to now, we have not encountered a satisfactory explanation of the impact of the degree of centralization in wage bargaining on wage formation. The empirical studies face severe measurement and methodological problems. Obviously, national wage bargaining systems show differences other than those in the degree of centralization which also need to be taken into account (see, for example, Traxler and Kittel, 2001).

Our experiment may be considered an attempt to deal, in a somewhat abstract way, with some aspects of the relationship between the degree of centralization in wage bargaining and the wage rates without trying, however, to test the hypothesis of a hump-shaped relationship. We compare the cases of complete decentralization and complete centralization; intermediate situations are not feasible with only two potentially merging parties.

A theoretical model dealing with the centralization question has also been presented by Horn and Wolinsky (1988). Their model examines the centralization decision in an industry where a firm employs two types of workers. The focus of the model is on potential gains from forming a joint venture. Jun (1989) examines a similar model where the focus is on how the gains are allocated among the members of the joint venture. Both models resemble ours in having a two-stage structure where the two groups of workers decide in the first stage on whether or not to form a joint venture. In contrast to our model, however, the second stage of their game relies on a non-cooperative bargaining process similar to the one presented by Rubinstein (1982).

In the following Section 2 we introduce our model and analyze it (game-)theoretically. As in Berninghaus et al. (1998), we use the (cooperative) bargaining solution introduced by Nash (1950, 1953) to select a unique equilibrium. The experimental design, explained in Section 3, concentrates on a parameter constellation in which only one of the potentially merging parties should be interested in merging. In Section 4 we present a statistical analysis of the experimental data. Section 5 concludes the article with a discussion of the major results.

## 2. The model

In our experiments there are three players, $X$, $Y$, and $Z$. They can negotiate either in a decentralized way or collectively. In the case of decentralized bargaining, $X$ negotiates with $Z$ about the allocation of a "pie" $P_{XZ} = 97$, and, independently, $Y$ negotiates with $Z$ about the allocation of a "pie" $P_{YZ} = 97$. In case of collective bargaining, $X$ and $Y$ first merge into $XY$ who then bargains with $Z$ about the allocation of the total "pie" $P_{XYZ} = 194$. Whatever $XY$ earns is equally divided between X and Y.

Let $i$ and $j$ be the two bargaining parties; i.e., $(i, j)$ is either $(X, Z)$ or $(Y, Z)$ or $(XY, Z)$. Like Berninghaus et al. (1998), we rely on a modified bargaining procedure of Nash (1950, 1953): Each of the two parties $k = i, j$ chooses a *demand* $D_k$ and a *bottom line* $B_k$ with $P_{ij} \geq D_k \geq B_k \geq C_k$, and where $C_k$ ($\geq 0$) denotes the *conflict payoff* of party $k$.

Given the vector $(D_i, B_i, D_j, B_j)$ of bargaining choices and the size of the "pie" $P_{ij}$, a *demand agreement* is reached if

$$D_i + D_j \leq P_{ij}$$

whereas a *bottom line agreement* is reached in the case of no demand agreement and

$$B_i + B_j \leq P_{ij}$$

Whereas both parties $k = i, j$ receive their demand $D_k$ in case of a demand agreement, their profits are determined by their bottom lines $B_k$ in case of a bottom line agreement. If none of these two agreements is achieved, the two parties end up in *conflict* with conflict payoffs $C_k$.

Since the conflict payoffs $C_k$ depend on the pairing $(i, j)$, we write $C_k(i, j)$. We concentrate on the following situation:

$$\begin{aligned} C_X(X, Z) &= 0\ , & C_Z(X, Z) &= c \\ C_Y(Y, Z) &= b\ , & C_Z(Y, Z) &= c \\ C_{XY}(XY, Z) &= a + b, & C_Z(XY, Z) &= 2c \end{aligned}$$

with

$$a, b, c > 0\ ;\ \ b + c < 97\ ;\ \ a + c < 97$$

Due to the fact that $C_Y(Y, Z) = b > 0 = C_X(X, Z)$, we can say that $Y$ is stronger than $X$.

To solve this game theoretically, we can consider the acceptance borders as the (only) essential strategic variables.[1] Obviously, in an efficient equilibrium the bargaining parties must choose

$$B_i + B_j = P_{ij}$$

To select a unique efficient equilibrium outcome as a benchmark solution we rely on the Nash bargaining solution, which maximizes the product of the dividends $(B_k - C_k)$ for $k = i, j$.

For the pair $(i, j) = (X, Z)$ we maximize $(B_X - 0)\ (B_Z - c)$ subject to $B_X + B_Z = 97$. This yields

$$B^*_X = 48.5 - c/2, \text{ and } B^*_Z = 48.5 + c/2$$

[1] The reason for allowing demand and bottom line agreements is the difficulty to coordinate on how to share the "pie" without preplay communication. Participants can try to reach their higher aspirations by high demands and play safe by more modest bottom lines.

For the pair $(i, j) = (Y, Z)$ we maximize $(B_Y - b)\ (B_Z - c)$ subject to $B_Y + B_Z = 97$. This yields

$$B^*_Y = 48.5 + (b - c)/2, \text{ and } B^*_Z = 48.5 + (c - b)/2$$

For the pair $(i, j) = (XY, Z)$ we maximize $(B_{XY} - a - b)\ (B_Z - 2c)$ subject to $B_{XY} + B_Z = 194$. This yields

$$B^*_{XY} = 97 + (a + b - 2c)/2, \text{ and } B^*_Z = 97 + (2c - a - b)/2$$

Recall that the payoff $B_{XY}$, or the conflict payoff $(a + b)$ are to be divided equally between $X$ and $Y$. Because $a + b > 0$ it follows that $B^*_{XY}/2 > B^*_X$. Thus, the weaker party X has an interest in forming $XY$.

In this experimental study, we will consider a situation where the stronger party $Y$ has no interest in forming $XY$. The condition $B^*_Y > B^*_{XY}/2$ has to be satisfied. Given, our parameter constraints, this implies $b > a$.

The actually chosen parameters are

$$a = 12,\ \ b = 24,\ \ c = 11$$

Table 1 shows the resulting solution payoffs for $X$, $Y$, and $Z$ under collective and decentralized bargaining. Obviously, each bargaining party receives its conflict payoff plus an equal share of the dividend. In the bottom row of Table 1 we have determined each player's incentives for centralizing as the difference of his payoff in the case of collective bargaining and his payoff in the case of decentralized bargaining. Of the three players only $X$ has positive incentives for centralizing. Our benchmark solution, thus, predicts decentralized bargaining.

The theoretical arguments above, which go beyond equilibrium requirements by employing the Nash-bargaining solution, do not necessarily correspond to our intuition of how boundedly rational participants will play such games. It might be a common experience or belief that one gains in strength by merging, based on factual or expected synergy. This sometimes finds expression in phrases like "unity is strength" or, in German, "Einigkeit macht stark". It is, therefore, important to note that we interpret the theoretical solution rather as a clear-cut benchmark than a likely hypothesis about actual behavior.

Although our basic game model is one with complete information (in the terminology of Harsanyi, 1967/68), one might argue that all interaction experiments are based on private information. Participants can never be sure how others perceive their decision environment and which kind of concerns they import into and develop during an experimental session. Thus, in the tradition of reputation equilibria (Kreps et al., 1982) the sequential decision process might allow players X and Y to signal their types, e.g., in the form: "Since I am tough, I will give you, *Z*, a hard time by voting for centralization". Such an interpretation is, however, rather arbitrary. Because of such arbitrariness one sometimes refers to reputation equilibria with uncontrolled incomplete information as "crazy perturbation models". If I consider myself as especially tough, I might also want to bargain for myself instead of merging with another—potentially weaker—partner. More importantly, we have ruled out actual signaling in our experiment by applying the strategy method (see Section 3 below). Thus, signaling would have to rely on stability requirements (Kohlberg and Mertens, 1986) rather than on ideas of sequential rationality as reputation equilibria.

## 3. Experimental Design

The experiments were organized at the University of Karlsruhe with students from various disciplines. Each subject was seated at a computer terminal. The experiment monitor distributed written instructions and read them aloud. Then each subject had to answer at his terminal a number of questions which tested the understanding of the instructions. Only when all subjects had correctly answered all questions could the experiment start. Subjects were not allowed to communicate other than through their decision making.

Each subject was randomly allocated the role of either player *X*, *Y*, or *Z*. Each subject participated in 20 negotiation rounds keeping the same role. The matchings of an *X*, a *Y*, and a *Z* player, however, were randomly determined in each round within matching groups of 9 players (3 players in each role). The subjects had complete information about the game, but they were not informed about the size of the matching group. In each round, all subjects made their decisions simultaneously and independently. These decisions represented complete plans prescribing decisions for all situations that might occur in that round.

The *X* and *Y* players had to declare whether they wanted to bargain collectively or not. Furthermore they had to choose an integer demand and acceptance border for individual and for collective bargaining. Similarly, the *Z* player had to choose an integer demand and acceptance border both for the individual negotiations with *X* and with *Y*, in case *X* and/or *Y* wanted to negotiate separately, and for the negotiation with *XY*, in case both *X* and *Y* wanted to negotiate collectively. When all players had made their decisions, it was determined whether decentralized or collective bargaining would take place and the appropriate negotiation was effectuated. For collective bargaining to take place, both *X* and *Y* had to vote for it. If only one of them opted for merging, decentralized bargaining took place. In the case of collective bargaining, it was randomly decided which of the two players, *X* or *Y*, was representing them in the negotiation with *Z*: his demand and bottom line for collective negotiation were put into play along with those of player Z. At the end of each round, each player was informed whether decentralized or collective bargaining had taken place and about his own individual payoff and the payoff of the party he was negotiating with.

We organized 8 sessions with 18 subjects, i.e., two matching groups, each. Thus, we obtained 16 independent observations (matching groups) in total. At the end of each session, each subject was privately paid in cash his accumulated payoff for the 20 rounds. The conversion rate was 3 pfennigs (0.03 deutsche mark, DM) for 1 experimental currency unit. The average payment was DM 24.88 for the subjects in the role of player *X*, DM 26.12 for those in the role of player *Y* and DM 47.19 for those in the role of player *Z*.

## 4. Experimental results

### 4.1 Collective or decentralized bargaining

Recall that theoretically the *X* player has an interest in collective bargaining while the *Y* player should prefer decentralized bargaining. As collective bargaining can take place only if both *X* and *Y* vote for it, the solution predicts decentralized bargaining. We observe, however, that (in the aggregate over all matching groups and rounds) 40 percent of all bargaining is collective. Fig. 1 shows the percentage of collective bargaining in each of the 20 rounds. The percentage of collective bargaining declines from 41 percent in the first 10 rounds to 39 percent in the second 10 rounds, but this decline is statistically insignificant (one-sided Wilcoxon signed rank test, 5 percent level). Of the *X* players' votes, 77 percent are for collective bargaining while of the *Y* players' votes, 51 percent are for collective bargaining. Thus, similar to Berninghaus et al. (1998), we find evidence in favor of the prediction in that the *X* players vote significantly more often for collective bargaining than the *Y* players (two-sided sign test, 1 percent significance level).

### 4.2 Bargaining behavior

Table 2 presents the average demands and bottom lines of players *X* and *Y* both in decentralized and in collective bargaining. It also presents the average demands and bottom lines of the *Z* players in negotiation with *X*, *Y,* and *XY*. We observe that all demands are significantly higher than the respective bottom lines (one-sided Wilcoxon signed rank test, 5 percent level). In other words, all player types in all situations tend to make concessions in that their bottom lines are below their demands. We observe no significant differences between the demands (or bottom lines) of *X* (or *Y*) players in decentralized and in collective bargaining. Neither do we observe significant differences between the demands (or bottom lines) of *X* players and *Y* players.[2] The *Z* players' demands show no significant differences whether they bargain with *X*, *Y,* or *XY*. The *Z* players' bottom lines, however, do significantly differ: their bottom lines in the negotiation with *X* are higher than those in the negotiation with *Y*, and their bottom lines in the negotiation with *Y* are higher than their bottom lines per player (i.e., half of their bottom lines) in the negotiation with *XY* (two-sided Wilcoxon signed rank test, 5 percent level). In other words, the *Z* players perceive the *Y* players to be stronger than the *X* players, but they perceive the joint venture *XY* to be even stronger than the two parties separately.[3] These differences show in the bottom lines rather than in the demands suggesting that bottom lines are behaviorally more relevant than demands .

Table 3 splits the demands and bottom lines of players *X* and *Y* according to whether the respective player voted for decentralized or for collective bargaining. We make the following observations (one-sided Wilcoxon signed rank tests, 5 percent level): *X* players who vote for collective bargaining demand significantly more than *X* players who vote for decentralized bargaining.[4] *Y* players who vote for collective bargaining demand, in the collective bargaining mode, significantly more than *Y* players who vote for decentralized bargaining. This is also true for the bottom lines. We conclude that *X* players who vote for collective bargaining think that they should try to achieve more in decentralized bargaining as well. *Y* players who are willing to bargain collectively try to do better in collective bargaining than *Y* players who are not willing to bargain collectively.[5]

Comparing demands and bottom lines (as presented in Table 2) to our benchmark solution (in Table 1), we observe the following (one-sided binomial tests, 5 percent level). In the case of decentralized bargaining, *X* players' demands and bottom lines and *Z* players' demands and bottom lines in negotiation with *Y* tend to be too high while *Y* players' bottom lines and *Z* players' demands and bottom lines in negotiation with *X* tend to be too low. In the case of collective bargaining, *X* and *Y* players' bottom lines are significantly too low, while *Z* players' demands are too high. Generally the bargaining behavior of the different players does not seem to reflect the strength that our benchmark solution attributes to them.

Demands and bottom lines are rather closely located around the equal split of the total "pie," i.e., 48.5. While the demands of the *X*, *Y,* and *Z* players, in decentralized and collective

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2 Note, however, that in decentralized bargaining the *Y* players' demand just fails significance for being higher than the *X* players' demand by p = 0.058.

3 If one considers strategic uncertainty as closely related to stochastic uncertainty, one could also explain the smaller *XY*-bottom lines of *Z*-participants as a reaction to the more risky negotiation with only one instead of two more or less probable agreements. Another interpretation would rely on an equity effect in the sense that there is a tendency to distribute rewards equally among all individual players involved in a negotiation.

4 This is true for their demand as *X*; it just fails significance for their demand as *XY* (p=0.051).

5 Note, however, that we do not know how seriously subjects considered the demands and acceptance borders for collective bargaining in situations where due to their own vote collective bargaining could not happen.

bargaining, significantly tend to be above half of the "pie," bottom lines significantly tend to be below half of the "pie" (one-sided binomial test, 5 percent level)—with the exception, however, of the *Y* players' demands and bottom lines (as the *XY* representative) in collective bargaining. Recall that according to our benchmark solution, the *Y* player's bottom line in decentralized bargaining, the *XY* player's bottom line, and the *Z* player's bottom line in the negotiation with *X* should be larger than half of the "pie."

Let us define a player's *concession* as the difference of his demand and bottom line. Table 4 presents the average concessions of *X*, *Y,* and *Z* players in decentralized and collective bargaining. In the case of collective bargaining we consider half of the concession, or the concession per player in *XY*. We observe no significant difference between the concessions of players *X* and *Y* and between decentralized and collective bargaining. Furthermore, we observe no significant differences between the concession of player *Z* and players *X* or/and *Y*. We observe, however, significantly higher concessions of *Z* players in collective bargaining than in decentralized bargaining (two-sided Wilcoxon signed rank test, 1 percent level). We may interpret this as further evidence that *Z* players perceive the joint venture *XY* as a stronger bargaining partner than either *X* or *Y* separately.

### 4.3 Agreements and conflicts

The relative frequency of demand agreements is 27.60 percent in decentralized bargaining and 28.13 percent in collective bargaining. The relative frequency of bottom line agreements is 60.76 percent in decentralized bargaining and 49.22 percent in collective bargaining. The relative frequency of conflicts is 11.63 percent in decentralized bargaining and 22.66 percent in collective bargaining. Table 5 shows the respective percentages separately for the bargaining situation between *X* and *Z* and between *Y* and *Z*. There appears to be no difference between them. In decentralized bargaining, bottom line agreements become significantly more frequent from the first 10 rounds to the second 10 rounds. In all cases, border agreements occur more often than demand agreements and conflicts. Thus, acceptance borders, which are the only strategically relevant bargaining moves, are also behaviorally more relevant than demands. The increasing relevance over time suggests that strategic thinking is learned. Another important effect revealed in Table 5 is the lower (higher) percentage of bottom agreements (conflicts) when parties bargain collectively.

### 4.4 Payoffs

The average payoffs per period realized by the *X*, *Y*, and *Z* players are 41.46, 43.53, and 78.65 respectively. Although the *Y* players on average gain significantly more than the *X* players (one-sided Wilcoxon signed rank test, 5 percent level), Y players gain only 79.1 percent of their theoretically predicted profit under decentralized bargaining while *X* players gain 96.4 percent of the predicted profit. *Z* players gain 82.8 percent of the predicted payoff and significantly less than the sum of the *X* and *Y* players' profits (one-sided Wilcoxon signed rank test, 5 percent level). Table 6 presents both the predicted and the average realized payoffs per round of each bargaining party in decentralized and collective bargaining. For the realized payoffs we determine the *X*, *Y*, and *Z* players' incentives for centralizing as the differences of payoff in collective bargaining and the payoff in decentralized bargaining. The incentives are 1.04, -2.40, and -14.83 for the *X*, *Y*, and *Z* player respectively. Thus, compared to the theoretical benchmark solution, the *X* players' incentive and the *Y* players' disincentive have become less important while the *Z* players disincentive has become more important.

We find significance for the following observations (one-sided Wilcoxon signed rank test; 5 percent level; all other comparisons show no significant difference): (1) The *Z* players' payoffs per *XY* player in collective bargaining tend to be lower than their payoffs in the negotiation with *X* alone (*a*) or *Y* alone (*b*). Thus, the *Z* players' total payoffs in collective bargaining tend to be lower than their sum of payoffs in decentralized bargaining. (2) In collective bargaining, the *Z* players' payoffs per *XY* player tend to be lower than those of the *X* players and those of the *Y* players. (3) In decentralized bargaining, the *Z* players' payoffs tend to be lower than those of the *Y* players but higher than those of the *X* players. (4) The *Y* players' payoffs in decentralized bargaining just fail significance for being larger than their payoffs in collective bargaining[6] and larger than the *X*

[6] Actually, p=0.051.

players' payoffs[7]. Of these observations only (1b) violates the prediction of the Nash bargaining solution.

## 5. Conclusions

We observe that in 40 percent of the cases the stronger *Y* players vote for collective bargaining although it is not in their strategic interest: not only according to the theoretical benchmark solution but also in the experiment (although this just fails significance) *Y* players do, on average, gain higher payoffs in decentralized than in collective bargaining. We suggest that the larger number of votes for collective bargaining by *Y* players might be influenced by an inequality aversion with respect to the *Z* players (Fehr and Schmidt,1999; Bolton and Ockenfels, 2000). In collective bargaining, *Z* players claim less than in decentralized bargaining. Thus, in collective bargaining *Z* players gain significantly lower payoffs than in decentralized bargaining—their payoffs in collective bargaining still being higher than those of the *X* or *Y* players, though.[8]

Demands and bottom lines are located around the equal split of the total "pie" (not around equal dividends as supposed by the Nash bargaining solution). Obviously, fairness considerations similar to those observed in ultimatum bargaining experiments also play some part in our experiment (see Roth 1995 for a survey). Interestingly, in case of collective bargaining, the pie is split equally between the two bargaining parties *XY* and *Z* but not between the three involved players *X*, *Y*, and *Z* as such.

*X* (and *Y*) players who vote for collective bargaining claim (in collective bargaining) a larger share of the pie for themselves than those who vote for decentralized bargaining. This supports the common claim that by forming a coalition a bargaining side may gain in strength (*unity is strength!*). According to game theory this claim is true only for specific (parameter) constellations different from the one we use (see Berninghaus et al., 1998). For our particular model, the benchmark solution predicts a minor loss for *Z* when *X* and *Y* merge (-6). In the experiment, we observe a much larger loss (-14.83).

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[7] Actually, p=0.051.

Our experiment may be considered another test of the Nash bargaining solution. Nydegger and Owen (1975) and Roth and Malouf (1979) have presented experiments designed to test the axioms of the Nash bargaining solution.[9] Keser, Rullière and Villeval (1999) also explore the predictive success of the Nash bargaining solution in an experiment where employers bargain with trade unions of different sizes. They observe that employers do not adapt their claims to the union's size as predicted by the Nash bargaining solution. Our data allow us, like Berninghaus et al. (1998), to compare the success of the Nash bargaining prediction in decentralized and collective bargaining. We observe that the behavior of *Z* players qualitatively reflects the strength relation between *X* and *Y* in the case of decentralized bargaining as suggested by our benchmark solution. However, in the case of collective bargaining, the strength of the joint venture is overvalued.

There could be an "irrational" fear of *Z* players regarding the joint venture (supported by the fact that *Z* players claim less from *XY* than they claim from *X* and *Y* separately). A more convincing explanation is offered by the *unity is strength* result discussed above. If *Z* has to bargain with *XY* instead of X and *Y* separately, both partners of the *XY* joint venture have voted for it. According to Table 3, those who vote for *XY* have higher aspirations than the average *X* or *Y* participant. Thus, voting for the joint venture can be seen as the determined self-selection of tough bargainers. In other words, when *XY* forms, Z confronts tougher bargaining partners than when *XY* does not form, as suggested by the signaling hypothesis in the (normal form) sense of stability considerations (Kohlberg and Mertens, 1986). This also explains the higher conflict rate in collective bargaining than in decentralized bargaining.

Let us summarize the major reasons why *Z* receives a much reduced payoff when *X* and *Y* merge to bargain collectively rather than individually and why negotiations end more often in conflict in centralized (22 percent) than in decentralized negotiations. First, one may assume that *Z* is risk averse: in case of decentralization a risk averse player *Z* has two independent chances to win whereas centralization leaves him just one chance to win. This should induce a more cautious

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[8] The theories by Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) account for the desire to reduce this payoff advantage of *Z* players. Whereas Fehr and Schmidt also allow that *Y* players care for the well-being of players *X* such a concern is ruled out by Bolton and Ockenfels.

[9] One might view bargaining experiments with free communication as adequate tests of the Nash bargaining solution. An impressive example is the KRESKO experiment by Tietz (1973), which does not only allow for free communication among players, represented by teams of participants, but also derives the payoff expectations of various wage settlements by computing their implications based on a complex macroeconomic model.

type of behavior in case of centralization, although not cautious enough for avoiding conflict as often as in decentralized negotiations. Second, it seems to be commonly believed and convincingly supported by our data that players *X* and *Y* who have merged are (expected to be) exceptionally tough and think that collective negotiations are better for playing tough. Here the two interpretations can be nicely linked by basing such a belief on the assumption that *X* and *Y* expect at least some *Z*-participants to be risk-averse.

From a more behavioral point of view, we might consider our results as evidence that people generally have learned to just believe that they become more powerful when bargaining collectively. Unlike players in game theory, human decision makers do not base their decisions always on the very specific details of the situation that they actually encounter but rather on general routines guiding their behavior in many situations (Selten, 1978; Cyert and March, 1963). One such routine might be: "Let us do it together since together we are strong". They actually become stronger that way.

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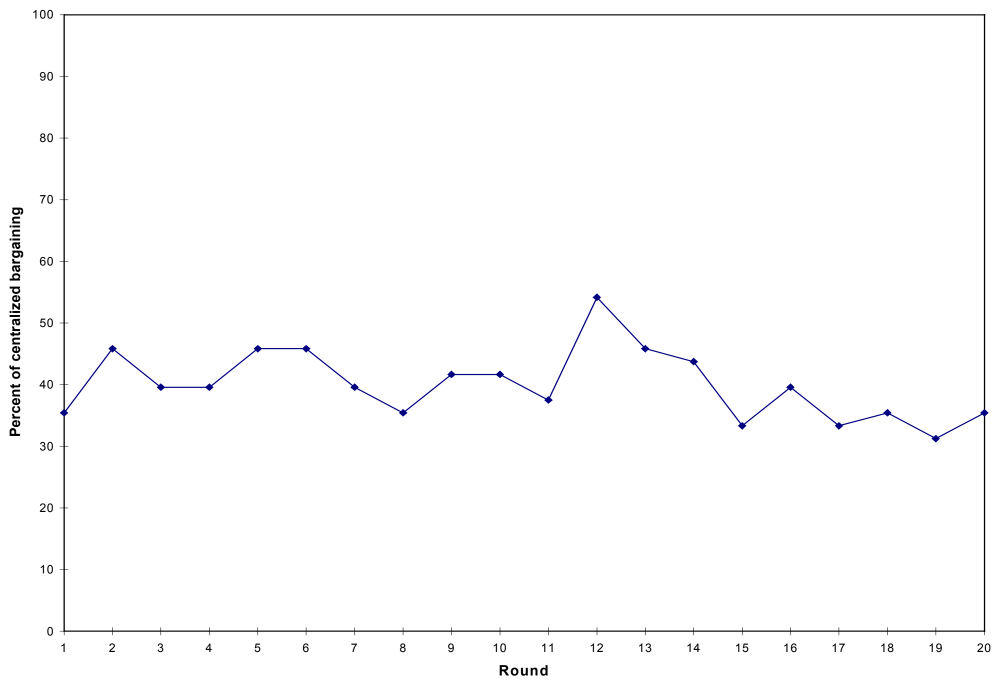


Fig. 1. Percent of collective bargaining in each of the 20 rounds.

Table 1
Payoffs for players *X*, *Y*, and *Z* under collective and decentralized bargaining, and each player's incentives for centralizing

| | X | Y | Z |
|---|---|---|---|
| decentralized bargaining | 43 | 55 | 96 [a] |
| collective bargaining | 52 | 52 | 90 |
| incentives for centralizing | 9 | -3 | -6 |

[a] 54 + 42

Table 2
Average demands and bottom lines

| | player *X* | | player *Y* | | player *Z* | | |
|---|---|---|---|---|---|---|---|
| | *X* | *XY* [a] | *Y* | *XY* [a] | *X* | *Y* | *XY* [a] |
| demand | 52.81 | 52.90 | 54.76 | 51.73 | 51.68 | 50.92 | 51.07 |
| bottom | 45.88 | 46.52 | 46.62 | 44.74 | 46.41 | 45.63 | 43.59 |

[a] per player

Table 3
Average demands and bottom lines of the *X* and *Y* players in voting against/for centralization

| | vote against centralization | | | | vote for centralization | | | |
|---|---|---|---|---|---|---|---|---|
| | player *X* | | player *Y* | | player *X* | | player *Y* | |
| | *X* | *XY* [a] | *Y* | *XY* [a] | *X* | *XY* [a] | *Y* | *XY* [a] |
| demand | 51.10 | 50.27 | 53.53 | 46.53 | 53.22 | 53.84 | 56.49 | 56.73 |
| bottom | 45.79 | 43.62 | 46.87 | 39.70 | 45.51 | 47.24 | 46.08 | 48.83 |

[a] per player

Table 4
Average concessions

| | player *X* | player *Y* | player *Z* toward *X* | player *Z* toward *Y* | player *Z* toward *XY* |
|---|---|---|---|---|---|
| decentralized | 6.93 | 8.14 | 5.27 | 5.29 | |
| collective [a] | 6.38 | 6.98 | | | 7.48 |

[a] per player

Table 5
Relative frequency of demand agreements, bottom line agreements and conflicts

| | | demand agreement | bottom agreement | conflict |
|---|---|---|---|---|
| collective | *XY–Z* | 28.13 | 49.22 | 22.66 |
| decentralized | *X–Z* | 27.78 | 60.76 [a] | 11.46 |
| | *Y–Z* | 27.43 | 60.76 [a] | 11.81 |

[a] Significantly increased from the first 10 rounds to the second 10 rounds (Wilcoxon matched pair signed rank test, 5 percent significance level, two-sided)

Table 6
The predicted and average realized payoffs per round in decentralized and collective bargaining (the realized payoffs include those in case of conflict)

| | negotiation parties (*i*, *j*) | payoff of party *i* | payoff of party *j* |
|---|---|---|---|
| Nash bargaining prediction | (X, Z) | 43 | 54 |
| | (Y, Z) | 55 | 42 |
| | (XY, Z) | 52 * | 45 * |
| realized payoff per round | (X, Z) | 41.04 | 42.73 |
| | (Y, Z) | 44.49 | 41.85 |
| | (XY, Z) | 42.09 * | 34.88 * |

* per player of party *i*

## Instructions

You are participating in an experiment in which you make decisions in groups of three. In each group of three there is one participant with each of the functions X, Y, and Z. Each of you will be randomly assigned to one of these functions.

In each group of three, contracts can be concluded between X and Z and between Y and Z. X and Y can negotiate with Z individually or jointly. Contract negotiation takes the form that all contract negotiators make their decisions known simultaneously and independently of one another. Each one gives both his/her demand—that is, his/her goal in the negotiations—and the bottom limit of what he/she is just barely prepared to accept.

<u>X negotiates with Z</u>

There are a maximum of 97 experimental currency units (ExCU) to be distributed between X and Z. Each negotiator names his/her demand and his/her bottom line. Both of these must be a whole number between zero and 97. In addition, the limit may not be greater than the demand.

If the sum of the demands of the two negotiating parties is less than or equal to 97, a **demand agreement** results: each negotiating party receives the exact amount of his/her demand. If the sum of the demands made by the two negotiating parties is greater than 97, the bottom lines of both negotiating parties are considered. If the sum of the bottom lines is less or equal to 97, a **bottom line agreement** results: each negotiating party receives the exact amount of his/her bottom line. If the sum of the bottom lines is greater than 97, no agreement is reached. In this case, X receives no payoff, whereas Z receives a payoff of 11 ExCU.

<u>Y negotiates with Z</u>

There are a maximum of 97 experimental currency units (ExCU) to be distributed between Y and Z. Each negotiator names his/her demand and his/her bottom line. Both of these must be a whole number between zero and 97. In addition, the limit may not be greater than the demand.

If the sum of the demands of the two negotiating parties is less than or equal to 97, a **demand agreement** results: each negotiating parties receives the exact amount of his/her demand. If the sum of the demands made by the two negotiating parties is greater than 97, the bottom lines of both negotiating parties are considered. If the sum of the bottom lines is less or equal to 97, a **bottom line agreement** results: each negotiating parties receives the exact amount of his/her bottom line amount. If the sum of the bottom lines is greater than 97, no agreement is reached. In this case, Y receives a payoff of 24 ExCU, and Z a payoff of 11 ExCU.

<u>X and Y negotiate jointly with Z</u>

In this situation, only one of the two partners X and Y negotiates on behalf of both with Z. Which of the two partners takes on this role is determined purely by chance. In the following we refer to the representative of X and Y as XY. There are a maximum of 194 experimental currency units

(ExCU) to be distributed between XY and Z. Each negotiating party can name his/her demand and his/her bottom line. Both of these must be a whole number between zero and 194. In addition, the limit may not be greater than the demand.

If the sum of the demands of the two negotiating parties is less than or equal to 194, a **demand agreement** results: each negotiating party receives the exact amount of his/her demand. If the sum of the demands made by the two negotiating parties is greater than 194, the bottom lines of both negotiating parties are considered. If the sum of the bottom lines is less or equal to 194, a **bottom line agreement** results: each negotiating party receives the exact amount of his/her bottom line amount. If the sum of the bottom line amounts is greater than 194, no agreement is reached. In this case, XY receives a payoff of 36 ExCU, and Z a payoff of 22 ExCU.

The amount negotiated by XY is divided equally between the two partners, X and Y. In the case of a demand agreement, X and Y each receive half of XY's demand. In the case of a bottom line agreement, X and Y each receive half of XY's bottom line amount. If no agreement is reached, X and Y each receive 18 ExCU.

The following table summarizes the individual payoffs for separate and joint negotiation if no agreement is reached between the respective negotiating parties.

| Negotiation between | Payoff if no agreement is reached for | | | Maximal amount to be distributed |
|---|---|---|---|---|
| | X | Y | Z | |
| X and Z | 0 | - | 11 | 97 |
| Y and Z | - | 24 | 11 | 97 |
| XY and Z | 18 | 18 | 22 | 194 |

<u>Sequence of events in a round of negotiations</u>

All players make their decisions simultaneously and independently of one another. They give their demand and bottom line for both separate and joint negotiation. None of the players knows at this point whether the negotiations will be separate or joint. Negotiator Z gives demand and bottom line amounts for separate negotiations with X and Y and for joint negotiations with XY. Under separate negotiations, Z can aim for different contracts with the two different negotiators. Negotiators X and Y likewise each name their demand and bottom line amounts for separate and joint negotiation with Z. **At the same time, they indicate whether they want to negotiate separately or jointly (mode of negotiation).**

As soon as all negotiating parties have made their decisions, it is determined whether X and Y are negotiating with Z separately or jointly. **Only if both have chosen joint negotiation do they negotiate with Z jointly as XY.** Otherwise individual negotiations with Z take place.

If there are separate negotiations, the corresponding demands and bottom lines of the negotiating parties are put into play. **If negotiation is joint, one of the two negotiating partners X and Y is randomly chosen as the representative XY.** His/her demand and bottom line for joint negotiations is put into play along with those of negotiator Z.

Information at the end of a round of negotiations

After a round of negotiations, each negotiator is informed as to whether the negotiations ended up separate or joint. If they were joint, players X and Y are told which of them acted as representative. In addition, each player is informed of the results of his/her individual negotiations, i.e., his/her payoff and that of the person(s) with whom he/she negotiated.

Number of rounds of negotiations

You will participate in a total of **20 rounds of negotiation**. Throughout the 20 rounds you will keep your same function as negotiator X, Y, or Z. However, in each round of negotiations new groups of three will be formed at random. The monetary amounts you gain in each round will be added up to yield your total winnings.

Payout

At the end of the experiment you will be paid in deutsche marks corresponding to your total winnings. One ExCU is equivalent to three pfennigs.

Using the computer program

Press the <F1> key if you want to see an overview of your negotiating strategies and results in all previous rounds.

With the <F2> key you obtain a short summary of these instructions on your monitor.

In either case, <ESC> returns you to input mode.

Input:
For each demand or bottom line, type in a value and press the <ENTER> key. If you have given a permissible number between 0 and 97 (or 194 for joint negotiation), the cursor will jump to the next input filed. If you are player X or Y, you must also indicate whether you want to negotiate jointly or not. If yes, press *y*; if not, press *n*. After the last input, which is finalized with <ENTER>, the program checks whether your demands are at least as high as the corresponding bottom lines. If not, you fall back into input mode, and can change the incorrect input numbers. To do so, you can use the arrow keys and the <Del> key, among others.