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Unity suggests strength: an experimental study of decentralized and collective bargaining

Siegfried Berninghaus[a], Werner Güth[b], Claudia Keser[c,d,*]

[a] *University of Karlsruhe, Germany*
[b] *Max Planck Institut, Jena, Germany*
[c] *IBM T.J. Watson Research Center, P.O. Box 218, Yorktown Heights, NY 10598, USA*
[d] *CIRANO, Montreal, Canada*

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Abstract

In an experiment, two players bargain with a third party, either separately or collectively after forming a joint venture. Our theoretical benchmark solution predicts decentralized bargaining, as only one of the players has an interest in forming a joint venture. However, we observe a significant share of collective bargaining. When compared with decentralized bargaining, centralization has no significant effect on the payoffs of the merged partners, but reduces the payoff of the third player due to more frequent conflicts caused by higher ambitions of the merged party.

JEL classification: C78; C92; J50
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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 founding of a *joint venture* or, in other words, the replacement of individual efforts by a common endeavor. Examples of such extreme forms of cooperation are mergers in industry, trade unions, political parties, and many other social groups. In real life situations, decisions on whether

* Corresponding author. IBM T.J. Watson Research Center, P.O. Box 218, Yorktown Heights, NY 10598, USA. Tel.: +1-914-945-2473; fax: +1-914-945-3242.
E-mail address: ckeser@us.ibm.com (C. Keser).

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or not to found a joint venture are influenced by many aspects: structural aspects could be changes in relative bargaining power, changes in negotiations rules, or the revelation of private information, while emotional aspects could be giving up autonomy, self image, changes in responsibility, or regret attribution. Examining the decision for or against merging, we can largely control for such confounding aspects in laboratory experiments. Our experiment, for instance, is designed to rule out that players can reduce the number of decisions by merging.

More specifically, in our experiment, players may either opt for a joint venture and bargain collectively or remain independent and bargain individually with a third party. The parties have to decide simultaneously for or against forming a joint venture and on their bargaining strategies with and without the joint venture.

Clearly, the aspect of founding a joint venture to bargain with a third party on a contract is crucial in wage bargaining. In modern societies, certain types of employees, such as chief executive officers (CEOs), individually negotiate their compensation, whereas the (minimum) wages of workers are typically determined collectively. In our experiment, we hope to shed new light on the debate of when and why collective bargaining is better than decentralized negotiations.

Even when we focus on collective bargaining, our basic problem of de(centralization) remains because collective bargaining is possible for a smaller or larger region (e.g., on the firm, regional or national levels of wage bargaining), as well as for fewer or more types of workers (e.g., by negotiating only the wages of truck drivers or the wages of truck, bus, and tram drivers in general).

The issue of (de)centralization will generally depend on the specific situation in which the problem arises. The aspects of the specific situation may, furthermore, be decisive. In case a great number of employees are involved, it is, for instance, simply too time consuming to individually negotiate the terms of employment relations. In our view, this justifies our attempt to study the (de)centralization problem in isolation, namely by considering an abstract bargaining problem, in which the implications of (de)centralized negotiations can be more easily understood than in a specific situation.

In a previous study (Berninghaus et al., 2001), a simple model of this joint venture problem is introduced and theoretically and experimentally investigated.[1] 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 opt against collective bargaining, while for the weaker party it is always better to opt for collective bargaining. This is reflected in the experimental data in that the weaker party opts for centralization more often than the stronger party.

[1] Compared to a related model by Selten and Gueth (1978), the one by Berninghaus et al. (2001) is much simpler due to the fact that it allows the third party, in case of decentralization, to aim at different agreements with the other two parties. Excluding discriminating agreements implies a three-person game with multiple equilibria to which the Nash (1950, 1953) bargaining solution cannot be applied.

While the model of Berninghaus et al. (2001) allows for only two possible contracts, many contracts are possible in the present experiment. Furthermore, in order to obtain a richer data set, we apply the strategy method by asking for complete behavioral plans. We simultaneously ask all subjects to submit complete strategies for playing the game. A strategy prescribes the bargaining decisions for both the cases of collective and decentralized bargaining in addition to the decision for or against forming a joint venture.

1.1. Centralization in wage bargaining

The potentially merging parties could represent trade union representatives who decide on whether they bargain collectively or individually on wages with the employers' representatives. The industrialized countries show large differences in wage bargaining structures. Wage bargaining can take place at several different levels. At one extreme, that is, decentralization (as, e.g., 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, that is, centralized bargaining (as, e.g., in the Scandinavian countries), national unions and employers' associations may bargain on a nationwide level. At the intermediate level (as, e.g., in Belgium, Germany, and the Netherlands), we may have bargaining on sectoral, branch, or industry levels.

In the macroeconometric literature, there is an ongoing 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, e.g., Traxler and Kittel, in press).

Our experiment may be considered an attempt to deal, in a somewhat abstract way, with some aspects of the relation between the degree of centralization in wage bargaining and the wage rates without trying, however, to test the hypothesis of a hump-shaped relation.[2] We compare the cases of complete decentralization and complete centralization; intermediate situations are not feasible with only two potentially merging parties. Our main findings state that the merger candidates are very interested in merging and that the third

[2] 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).

party is more afraid of negotiating with the merged party than negotiating with them individually. When and why parties merge is poorly related to the game theoretic benchmark solution that relies on equilibrium selection. Even the party that should not merge at all suggests a merger in more than half of the cases.

In Section 2, we introduce our model and analyze it (game) theoretically. As in Berninghaus et al. (2001), 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" $P_{YZ}=97$.[3] In the 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, that is, (i, j) is either (X, Z) or (Y, Z) or (XY, Z). Like Berninghaus et al. (2001), 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

$$D_i + D_j \leq P_{ij} \tag{1}$$

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

$$B_i + B_j \leq P_{ij} \tag{2}$$

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.[4]

[3] Note that Z can commit to different agreements with X and Y. Forcing Z to offer the same terms would render decentralized bargaining a more complicated three-person game, although the qualitative aspects of the solution largely pertain (Selten and Gueth, 1978).

[4] The reason for splitting up the bargaining choice into demand and bottom line is that, although game theory does not account for this, it seems to help the parties to coordinate more easily on how to split the surplus. Behaviorally speaking, demands can aim at an efficient allocation, whereas bottom lines can be seen as a way to avoid conflict.

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

$$
\begin{aligned}
&C_X(X,Z) = 0, && C_Z(X,Z) = c \\
&C_Y(Y,Z) = b, && C_Z(Y,Z) = c \\
&C_{XY}(XY,Z) = a + b, && C_Z(XY,Z) = 2c
\end{aligned}
\tag{3}
$$

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 consider the acceptance borders as the (only) essential strategic variables.[5] Obviously, in an efficient equilibrium, the bargaining parties must choose

$$B_i + B_j = P_{ij} \tag{4}$$

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 yields

$$B_X^* = 48.5 - c/2,\ \text{and}\ B_Z^* = 48.5 + c/2 \tag{5}$$

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

$$B_Y^* = 48.5 + (b - c)/2,\ \text{and}\ B_Z^* = 48.5 + (c - b)/2 \tag{6}$$

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

$$B_{XY}^* = 97 + (a + b - 2c)/2,\ \text{and}\ B_Z^* = 97 + (2c - a - b)/2 \tag{7}$$

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 $b > a$.

[5] 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 playing safe using more modest bottom lines.

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.

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 their conflict payoff plus an equal share of the dividend. In the bottom row of Table 1, we defined each player's incentives for centralizing as the difference between their payoff in the case of collective bargaining and their 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 as a clear-cut benchmark rather than a likely hypothesis about actual behavior.

Participants might view (the choice of) centralization as signaling "I am tough". Such an interpretation is, however, rather arbitrary. If I consider myself as especially tough, I might also want to bargain for myself instead of merging with another, potentially weaker partner.

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 (available at http://www.cirano.qc.ca/experimenteconomics/), informing participants about the game and the experimental procedure and read them aloud. Then each subject had to answer at their 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 nine players (three players per role). To encourage the stranger design, participants were not told that rematching is restricted to smaller matching groups. 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 collective bargaining. Similarly, the *Z* player had to choose an integer demand and acceptance border both for the individual negotiations with *X* and *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 effected. For collective bargaining to take place, both *X* and *Y* had to opt 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*: this player's 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, about their own individual payoff, and the payoff of the party they were negotiating with.

We organized 8 sessions with 18 subjects, that is, 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 their accumulated payoff for the 20 rounds. The conversion rate was three pfennigs (0.03 deutsche mark, DM) for one experimental currency unit. The average payment was DM 24.88 for the subjects allocated the role of player *X*, DM 26.12 for those allocated the role of player *Y*, and DM 47.19 for those allocated 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* opt for it, the solution predicts decentralized bargaining. We observe, however, that (in the aggregate over all matching groups and rounds) 40% of all bargaining is collective. Fig. 1 shows the percentage of collective bargaining and the percentage of *X* and *Y* players opting for collective bargaining in each of the 20 rounds. The percentage of collective bargaining declines from 41% in the first 10 rounds to 39% in the second 10 rounds, but this decline is statistically insignificant (one-sided Wilcoxon signed ranks test, 5% level). Over all 20 rounds, 77% of the *X* players' choices and 51% of the *Y* players' choices support collective bargaining. Thus, similar to Berninghaus et al. (2001), we find evidence in favor of the prediction in that the *X* players opt significantly

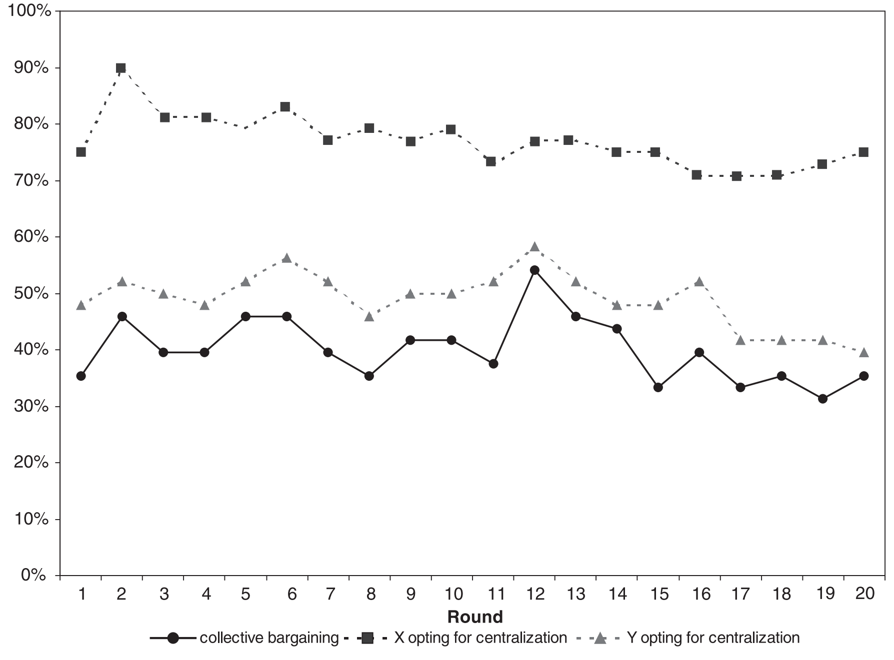

Fig. 1. Percent of collective bargaining in each of the 20 rounds.

more often for collective bargaining than the *Y* players (two-sided sign test, 1% significance level).

4.2. Bargaining behavior

Table 2 presents the average demands and bottom lines of players *X* and *Y* both in decentralized and collective bargaining. It also presents the average demands and bottom lines of the *Z* players in the negotiation with *X*, *Y*, and *XY*. We observe that all demands are significantly higher than the respective bottom lines (one-sided Wilcoxon signed ranks test, 5% 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 or collective bargaining. Neither do we observe significant differences between the demands (or bottom lines) of *X* and *Y* players.[6] 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-

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

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.

sided Wilcoxon signed ranks test, 5% 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.[7] These differences are reflected in the bottom lines rather than the demands.

Table 3 splits the demands and bottom lines of players *X* and *Y* according to whether the respective player opted for decentralized or for collective bargaining. We make the following observations (one-sided Wilcoxon signed ranks tests, 5% level): *X* players who opt for collective bargaining demand significantly more than *X* players who opt for decentralized bargaining.[8] *Y* players who opt for collective bargaining demand significantly more in the case of collective bargaining than do *Y* players who opt for decentralized bargaining. This is also true for the bottom lines. We conclude that *X* players who opt for collective bargaining apparently think 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.[9]

Comparing demands and bottom lines (as presented in Table 2) to our benchmark solution (Table 1), we observe the following (one-sided binomial tests, 5% level): *X* players' demands and bottom lines are too high in decentralized bargaining, but their bottom lines are too low in collective bargaining. *Y* players' bottom lines are too low both in decentralized bargaining and collective bargaining. *Z* players' demands and bottom lines are too high in the negotiation with *Y* and too low in the negotiation with *X*. In the case of collective bargaining, *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", that is, 48.5. While the demands of the *X*, *Y*, and *Z* players in decentralized and collective 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% level)—with

[7] 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 focus on an equity effect in the sense that there is a tendency to distribute rewards equally among all individual players involved in a negotiation.

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

[9] 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 choice, collective bargaining could not happen.

Table 3
Average demands and bottom lines of the X and Y players when opting against/for centralization

	Player X				Player Y			
	Opting against		Opting for		Opting against		Opting for	
	X	XY[a]	Y	XY[a]	X	XY[a]	Y	XY[a]
Demand	51.10	50.27	53.22	53.84	53.53	46.53	56.49	56.73
Bottom	45.79	43.62	45.51	47.24	46.87	39.70	46.08	48.83

[a] Per player.

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 that player's 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 or between decentralized and collective bargaining. Furthermore, we observe no significant differences between the concessions of player Z and players X or Y. We observe, however, significantly higher concessions of Z players in collective bargaining than in decentralized bargaining (two-sided Wilcoxon signed ranks test, 1% 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 relatively low in both decentralized bargaining (27.60%) and collective bargaining (28.13%). The relative frequency of bottom line agreements is 60.76% in decentralized bargaining, while it is only 49.22% in collective bargaining. The relative frequency of conflicts is 11.63% in decentralized bargaining while it is as high as 22.66% 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, bottom line agreements occur more often than demand agreements and conflicts. Thus, acceptance borders, which are the only strategi-

Table 4
Average concessions

	Player X	Player Y	Player Z		
			Toward X	Toward Y	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 ranks test, 5% level, two-sided).

cally 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 line agreements (conflicts) when parties bargain collectively. The conflicts in collective bargaining were caused by player *Y* being the tougher representative of *XY*: in 66.82% of the cases when collective bargaining ended in conflict, player *Y* was the actual representative. In 14 of the 16 groups, it was mostly the *Y* player rather than the *X* player acting as the *XY* representative who caused the conflict, implying 1% significance (two-sided binomial test). In case of the demand agreement (bottom line agreement), the *Y* player was the representative in 46.30% (47.62) of all cases. Thus, for neither type of agreement can we reject the null hypothesis that *X* and *Y* are equally likely as *XY*-representatives (requiring significance at the 5% level for the one-sided binomial test).

4.4. Payoffs

The average payoffs per period realized by *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 ranks test, 5% level), *Y* players gain only 79.1% of their theoretically predicted profit under decentralized bargaining, while *X* players gain 96.4% of the predicted profit. *Z* players gain 82.8% of the predicted payoff and significantly less than the sum of the *X* and *Y* players' profits (one-sided Wilcoxon signed ranks test, 5% 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 define the *X*, *Y*, and *Z* players' incentives for centralizing as the

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

	Negotiating 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[a]	45[a]
Realized payoff per round	(*X*, *Z*)	41.04	42.73
	(*Y*, *Z*)	44.49	41.85
	(*XY*, *Z*)	42.09[a]	34.88[a]

[a] Per player of party *i*.

differences of payoff in collective bargaining and payoff in decentralized bargaining. The incentives are 1.04, -2.40, and -14.83 for the *X*, *Y*, and *Z* players, 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 ranks test, 5% 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 the sum of their 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[10] and being larger than the *X* players' payoffs.[11] Of these observations, only (1b) violates the prediction of the Nash bargaining solution.

5. Conclusion

We observe that in 51% of the cases the stronger *Y* players opt 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 on average gain higher payoffs in decentralized than in collective bargaining. We suggest that the many choices of collective bargaining made by *Y* players might be influenced by some kind of inequality aversion with respect to the other players (Fehr and Schmidt, 1999; Bolton et al., 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.[12]

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). Remember, however, that if in the case of collective bargaining, the pie is split equally between the two bargaining parties *XY* and *Z*, this does not imply equal payoffs for players *X* or *Y*, and *Z*.

X (and *Y*) players who opt for collective bargaining claim (in collective bargaining) a larger share of the pie for themselves than those who opt for decentralized bargaining. This

[10] Actually, $p = 0.051$.

[11] Actually, $p = 0.051$.

[12] The theories by Fehr and Schmidt (1999) and Bolton et al. (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.

supports the common claim that by forming a coalition a bargaining side becomes more ambitious (*unity suggests strength*), which, however, need not imply larger payoffs due to an increase of conflicts. Actually, in our experiments, unity did not induce significantly larger payoffs. According to game theory the *unity suggests strength* claim is true only for specific (parameter) constellations different from the one we use (see Berninghaus et al., 2001). Note, however, that 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).

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, both experiments indicating a strong motivation to aim at equal monetary payoffs (or expectations in the case of Roth and Malouf, 1979).[13] Keser et al. (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, as in Berninghaus et al. (2001), 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 from *X* and *Y* separately). A more convincing explanation is offered by the *unity suggests strength* result discussed above. If *Z* has to bargain with *XY* instead of *X* and *Y* separately, both partners of the *XY* joint venture opted for it. According to Table 3, those who opt 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 (23%) rather than 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 *Z* just one chance to win. This should induce a more cautious type of behavior in case of centralization, although not cautious enough to avoid conflict as often as in decentralized negotiations. Second, it seems to be commonly believed and is convincingly supported by our data that players *X*

[13] 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.

and Y who have merged are (expected to be) exceptionally tough and apparently think that collective negotiations are better for playing tough. Here the two interpretations can be nicely linked, 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 have generally learned to believe that they will be more powerful when bargaining collectively. Unlike players in game theory, human decision makers do not base their decisions always on the specific details of the situation 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 with respect to the third party, although their actual payoffs might decrease.

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