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REPEATED PRICE COMPETITION BETWEEN INDIVIDUALS AND BETWEEN TEAMS

by

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Repeated Price Competition between Individuals and between Teams [1]

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Abstract: We conducted an experimental study of price competition in a duopolistic market. The market was operationalized as a *repeated* game between two "teams" with one, two, or three players in each team. Each player simultaneously demanded a price, and the team whose total asking price was smaller won the competition and was paid its asked price. The losing team was paid nothing. In case of a tie, the teams split the asking price. For teams with multiple players we manipulated the way in which the team's profit was divided between the team members. In one treatment each team member was paid his or her asking price if the team won, and half that if the game was tied, while in the other treatment the team's profit for winning or tying the game was divided equally among its members. We found that asking (and winning) prices were significantly higher in competition between individuals than in competition between two- or three-person teams. There were no general effects of team size, but prices were sustained at a higher level when each team member was paid his or her own asked price than when the team's profits were divided equally.

Repeated Price Competition between Individuals and between Teams.

1. Introduction

Oligopolists are typically modeled as unitary, profit-maximizing firms. However, an oligopolist can also be an alliance of firms. Suppose, for example, that a community wants to construct a new city hall. The project is too large for any local firm to handle by itself and several of them get together to make a common bid. Suppose further that there are several such composite bidders and that the city will give the contract to the lowest bidder. Assume that it is clear what part of the project each firm in the alliance will complete: one will build the structure, another will provide the landscaping, a third will install the electrical system; etc. Then the problem arises of how much of the common bid should go to each member of the alliance if they win the competition.

Obviously, this is a bargaining problem. The simplest way of modeling the negotiations is to let each firm in the alliance ask for a certain amount, with the common bid being determined as the sum of all these amounts. This admittedly simplistic model has the advantage of being easily amenable to theoretical and experimental investigation. Moreover, even if there is extensive verbal interaction between the business partners, it may be looked upon as cheap talk. In the end, everyone has to make an independent decision as to how much they want to charge, and the sum of all the demands will be submitted as the group's bid. In this way, the situation can be seen as a non-cooperative game. Of course, communication before the final choice is made would probably have an impact on the final outcome, but in the current investigation we are only studying the purely non-cooperative interaction of making the final demands.[2]

The purpose of this study is to examine how the alliance's size and internal structure affects the outcome of a Bertrand price competition. With this goal in mind we conducted an experiment in which a price competition game was played by two "teams" with one, two, or three players in each team.[3] Each player simultaneously demanded a price (an integer between 2 and 25). The team whose total demand was smaller won the competition and was paid its price. The losing team was paid nothing. In case of a tie, the teams split the demanded price. For teams with multiple players we manipulated the way in which the team's profit was divided between the (two or three) team members. In one treatment each individual player was paid his or her own demand if the team won (half of the demand if the game was tied). In the other treatment the team's profit for winning or tying the game was divided equally among its members. We refer to these treatments as 'private profit' and 'shared profit', respectively (Rapoport and Amaldoss, (1999), refer to these distribution rules as "proportional" and "egalitarian").

[2] While it is obviously important to conduct experiments that include a cheap talk stage, experiments with anonymous formal interaction are also relevant and interesting. In fact, it is common practice in theoretical and experimental economics to investigate strategic situations as non-cooperative games without the opportunity to engage in any form of communication beyond the formal interaction. The Ultimatum game, the Gift Exchange game, the Trust game and many other games are mostly investigated in this way, even if the real-life situations modeled by these paradigms usually involve extensive communication between the participants. It is clearly desirable to study all these situations with the opportunity for communication as well – and this has been done to some extent - but as far as the game considered here is concerned, this has to be left to future investigation.

[3] Fouraker and Siegel (1963) were the first to study price competition experimentally. The particular game employed in this study, played by individual players, was first studied by Dufwenberg & Gneezy (2000).

Manipulating the teams' internal structure is intended to disentangle the two fundamental problems – free riding and coordination - that distinguish a team from a truly unitary player. When prices are above the competitive minimum, the 'private profit' treatment provides each player with an opportunity, indeed a temptation, to free ride. Namely, if the other players in her team settle for a low price, a player can demand a higher price and yet may win. In the 'shared profit' treatment, where equal division of profits is imposed, the opportunity for free riding is eliminated. However, since team members have to actuate a joint strategy without communicating, they still face a coordination problem. Individual players are obviously spared both of these internal problems.[4]

The unique strict Nash equilibrium of the price competition stage-game, *regardless* of whether the participants are individuals or teams and how profits are distributed within the teams, is for each player to demand the minimal price (of 2 points).[5]

However, when the game is played repeatedly by the same teams[6], as in the present study, the set of equilibria is much larger. In an ongoing interaction, behavior can depend on the earlier choices of other players in one's own group and/or the competing group and therefore outcomes that would be regarded as irrational in a

[4] The 'shared profit' treatment amounts to having a committee determine the total bid by aggregating the individual bids submitted, and split the profit evenly among the players. This arrangement eliminates the within-team competition, but it is admittedly not very realistic. Our main interest is clearly in the 'private profit' treatment, where there is a partial conflict of interests within the team, while the 'shared profit" treatment, where internal competition does not exist, serves as a meaningful baseline.

[5] There are also non-strict Nash equilibria in which the bid of a member of a losing team does not affect the outcome.

[6] Strictly speaking, there is no way to design an experiment with an infinite number of repetitions. The fact that there is an upper (even unknown) limit on the number of repetitions gives rise to considerations of backwards induction, resulting in one equilibrium: that of the one-shot game. Nevertheless, it is known from experimental literature that participants still regard the game as a repeated interaction, at least until the last few rounds.

one-shot game may be perfectly rational when the game is repeated. In particular, the collusive outcome, where all players of both teams ask the maximal (i.e. monopoly) price, is supported by a Nash equilibrium.[7]

Our primary interest is indeed in the issue of tacit collusion. With repeated interaction, the competitors might be able to collude in a purely non-cooperative manner to sustain higher prices than predicted by the one-shot Bertrand model (Tirole, 1988). In the present study we investigate whether the teams' size and their internal profit-sharing arrangements affect the likelihood of collusion.

One obvious predictor of the likelihood of cooperation is the number of decision makers or players involved. The prospect of successful cooperation decreases as the number of players increases (Hamburger, Guyer, & Fox, 1975). Hence, the mere complexity of a competition between two-person and three-person teams as compared with a competition between individuals renders the realization of common interests in the larger games more difficult. It is not clear, however, whether the relationship between team size and cooperation is strictly monotonic. An alternative hypothesis is that there is a qualitative difference between individual players, who do not face internal conflicts and coordination problems, and groups (of any size > 1). The current design will allow us to address this question directly.

[7] Our objective is not to provide a full analysis of the repeated price-competition game, or account for all its strategic aspects. We simply wish to examine difference in behavior between individuals and teams in a realistic, repeated-game setting. Following the work by Fouraker and Siegel (1963), most price competition experiments employed a repeated-game design (see Plott, 1989, and Holt, 1995, for overview of this literature).

Another potential predictor of the prices in the market is the profit-sharing arrangements within the competing groups. As discussed above, an iterated game makes tacit collusion between the two competitors possible. But if cooperation fails, this setup provides the individual players with the opportunity to learn the structure of the stage-game and adapt their behavior accordingly. Recently Bornstein and Gneezy (2002) reported that the pace of adaptation depends largely on the teams' internal structure. Bornstein and Gneezy studied price competition between two (three-person) teams using a 'strangers' design, and found that convergence to the competitive price was much faster in the 'shared profit' treatment than in the 'private profit' one[8]. Their explanation for this outcome is rather simple. In both treatments a high demand by player *i* is likely to result in *i*'s team losing the competition and *i* receiving a payoff of zero. However, if *i*'s team ends up winning the competition, *i*'s payoff is higher in the 'private profit' than in the 'shared profit' treatment, where he or she has to share it with his or her team mates. Since high demands are punished more consistently in the 'shared profit' than in the 'private profit' treatment, where a high demand can occasionally lead to high personal profit, players learn to reduce prices faster in the former treatment. By extending this reasoning to the current repeated-game or 'partners' design, we conjecture that prices will remain higher in competition between 'private profit' groups than in competition between 'shared profit' groups.

[8] Gunnthorsdottir and Rapoport (unpublished) find similar results in an inter-group public goods game where the prize for winning the inter group competition is divided either equally or in proportion to each member's contribution. However, the different structure of their competition leads to theoretically higher contribution levels in the proportional division, while in Bornstein and Gneezy (2002) the profit sharing does not alter the theoretical solution.

2. Experimental Procedure

Subjects and Design: The participants were 264 undergraduate students (65% females) at the Hebrew University of Jerusalem. Participants were recruited by campus advertisements offering monetary rewards for participating in a decision-making experiment. They had no previous experience with this task. Players participated in the experiment in cohorts of 12; 8 such cohorts took part in the two-person team treatments, and 12 cohorts in the three-person team treatments. Half of these cohorts were in the 'private profit' treatment and half in the 'shared profit' treatment. Finally, two cohorts participated in the individual treatment. Thus we have 12 independent observations in each of the five cells in our design, as shown in Table 1.

<Insert table 1 here>

Procedure: Upon arrival at the laboratory each participant received a payment of NIS 10 for showing up[9] and was seated in separate cubicle facing a personal computer. The participants were given written instructions concerning the rules and payoffs of the game (see Appendix) and were asked to listen carefully while the experimenter read the instructions aloud. Then participants were given a quiz to test their understanding of the rules. The experimenters checked their answers and, when necessary, the explanations were repeated. Participants were also told that to ensure the confidentiality and anonymity of the decisions they would receive their payments

[9] At the time the experiment was conducted the exchange rate was approximately NIS 4 = $1.

in sealed envelopes and leave the laboratory one at a time with no opportunity to meet the other participants.

Participants played 100 rounds of the game, but the number of rounds was not revealed to the players in advance.[10] At the beginning of the first round the 12 participants were randomly divided into one-, two-, or three-person teams, depending on the treatment, and each team was randomly matched with another team of the same size. At the beginning of each round each player had to enter a demand of 2 to 25 points. Following the completion of the round, the participant received feedback concerning (a) the total number of points demanded by the members of his or her team on that round; (b) the total number of points demanded by the members of the competing team on that round; (c) the number of points he or she earned on that round; and (d) his or her cumulative earnings (in points). Following the last round, the participants were debriefed on the rationale and purpose of the study. The points were cashed in at a rate of NIS 1 per 10 points and the participants were dismissed individually.

3. Results

3.1 Teams are generally more competitive than individuals:

Table 2 presents the mean price requests per player and the mean winning price (summed across all rounds), as well as their mean ranks, for each of the 5 treatments. These means were analyzed using a non-parametric Kruskal-Wallis test. This test ranks the 60 independent observations in our experiment (12 observations X 5 treatments) from the lowest to the highest. The difference in mean ranks among the 5

[10] In order to avoid end effects we did not tell the participants exactly how many rounds would be played (but they knew there would be many rounds).

treatments is statistically significant for both the mean price and the mean winning price ($\chi^2_{(4)}$=15.69, p<0.05 and $\chi^2_{(4)}$=12.75, p<0.05, respectively).

This effect can be attributed mainly to the fact that prices in the individual treatment were significantly higher than those in the group treatments. We decomposed the effect into 4 orthogonal contrasts (see e.g., Marascuilo & McSweeney, 1977). Comparing the individual treatment to the 4 group treatments reveals a significant difference both for the mean asking price and the mean winning price (($\chi^2_{(1)}$=12.72, p<0.05 and $\chi^2_{(1)}$=9.75, p<0.05, respectively). Comparing the 2-member group treatments to the 3-members group treatments indicates that the difference is not significant (($\chi^2_{(1)}$=2.59, n.s. and $\chi^2_{(1)}$=2.00, n.s., for the mean price and the mean winning price, respectively). The differences between the 'shared' and 'private' profit treatments in the mean price and the mean winning price were also not significant (($\chi^2_{(1)}$=0.344, n.s. and $\chi^2_{(1)}$=0.9, n.s., respectively), nor were the interactions between group size and profit sharing arrangement ($\chi^2_{(1)}$=0.03, n.s. and $\chi^2_{(1)}$=0.093, n.s., respectively). We can conclude then that in competition between individuals prices tend to be higher than in competition between teams. However, neither the size of the teams nor the profit-sharing arrangement within them has an influence on average prices.

<Insert Table 2 here>

<u>3.2 Prices set by teams tend to decrease whereas individuals often increase prices over time:</u>

Next we turn our attention to the dynamics of prices over time. To facilitate presentation of the results and minimize the effects of trial-to-trial fluctuations, the

100 rounds were placed in 10 blocks of 10 consecutive rounds each. Figures 1a and 1b, respectively, present the mean asking prices and the mean winning prices per block for each group size.

<Insert Figures 1a and 1b here>

To analyze the changes in asking prices over time, we computed for each observation the Kendall rank-correlation (τ_b) between the mean asking price per (10 trial) block and the block number. The correlation is positive if prices increase over time, negative if they decrease over time, and 0 if there is no trend. The next table summarizes the distribution of these correlations and their mean values for each of the five treatments.

<Insert Table 3 here>

We subjected the Kendall correlations to a Kruskal-Wallis test, which indicates an overall treatment effect for the mean asking price ($\chi^2_{(4)}$=10.47, $p<0.05$) but not for the mean winning price ($\chi^2_{(4)}$=8.375, n.s.). When the global test is decomposed into 4 orthogonal contrasts, we find no differences between the individual and the group treatments ($\chi^2_{(1)}$=1.7, n.s. and $\chi^2_{(1)}$=2.38, n.s., for the mean asking price and the mean winning price, respectively). The 2-person groups and the 3- person groups are also not significantly different ($\chi^2_{(1)}$=1.96, n.s. and $\chi^2_{(1)}$=0.522, n.s., for the mean asking price and the mean winning price, respectively). We do find a significant difference between the 'private-profit' and the 'shared-profit' treatments in both the mean asking price and the mean winning price ($\chi^2_{(1)}$=6.8, $p<0.05$ and $\chi^2_{(1)}$=5.30, $p<0.05$, respectively), and there is no significant interaction between group size and profit-sharing arrangement ($\chi^2_{(1)}$=0.004, n.s. and $\chi^2_{(1)}$=0.17, n.s., for the mean asking price and the mean winning price, respectively)

<u>3.3 Prices increase in competition between 'private-profit' teams and decrease in competition between 'shared-profit' teams</u>

The above analysis indicates a differential trend of prices over time in the two types of profit-sharing arrangements. To further examine this issue, we computed Mann-Whitney U tests on the rank-correlations and found the correlations to be significantly higher in the private-profit than in the shared-profit treatment (p=0.075 for 2-person groups; p=0.04 for three person groups; p=.01 when these two treatments are combined; by a two-sided test).[11] There is no significant difference between the rank-correlations of individuals and 'private-profit' groups, however, there is a significant difference between individuals and 'shared-profit' groups (p=0.019 for asking prices and p=0.009 for winning prices, by tow-tailed test).

Of course, the above analysis cannot tell whether the correlations in each treatment are mostly positive or mostly negative (the Mann-Whitney U test only looks at relative difference, and would yield the same results whether all correlations are positive or all are negative). Therefore, we counted the number of positive and negative correlations in each profit-sharing treatment (summed across the two group-size treatments, see Table 3). We found that the distribution of positive and negative correlations is distinctly affected by the profit-sharing arrangement. The correlations

[11] Similar results are obtained for winning prices.

between asking-price and block number are mostly positive (17 out of 24) in the 'private-profit' treatment, indicating that prices often increase over time, and mostly negative (18 out of 24) in the 'shared-profit' treatment, indicating that prices frequently decrease over time. The difference between the two distributions is statistically significant by a Fisher Exact Test (p=0.0015).[12]

To summarize, the pattern of price change over time in the 'shared-profit' treatments is different from that in the 'private-profit' ones: Prices tend to increase over time when profits are private, and to decrease over time when profits are shared. This trend is depicted in Figures 2a and 2b for the mean asking price and the mean winning price, respectively (summed over the two group sizes).

<**Insert Figures 2a and 2b here**>

<u>3.4 Teams do not manage to collude as efficiently as individuals.</u>

Finally, we looked at the occurrences of ties. Ties are observed more often in the individual than in the group treatments: 36.75% of the games between individuals end up in a tie, compared to only 8.67% in the multiple-player groups[13]. Moreover, the rate of ties in the individual treatment increased systematically as the game

[12] The distributions of the winning price are practically the same and are also significantly different.

[13] The 2,400 *individual* asking prices can be used to calculate the probability of tied games in every condition by chance alone, i.e., assuming that there is no difference over the 100 rounds and that the players are independent (both within and between groups). The probability of a chance tie is 0.111 for single players, 0.033 for dyads, and 0.021 for triples. Clearly, there are more ties than expected by chance in all cases, indicating some tacit coordination among players, but the rate is considerably higher for individuals than for groups.

progressed (from 22.5% in the first block to 46.67% in the last one), whereas in the other treatments it remained quite stable across blocks.

Clearly, it is important to consider the values at which the teams reach a tie. In Table 4 we distinguish between three cases: (a) all players request 2, the lowest possible price, which is the single Nash equilibrium of the stage game, (b) all players request 25, the highest possible price, which is the collectively efficient (profit maximizing) outcome, and (c) the average request per player is some other amount between 2 and 25.

<Insert Table 4 here>

There is a significant difference ($\chi^2_{(8)} = 467.3$; $p < 0.05$) between the patterns of ties recorded in the single- and multiple-player groups: Most ties (57%) between individuals are collectively efficient (i.e., monopoly) prices, and the number of efficient ties increases from 11.67 % in block 1 to 30% in block 10, but there is not even one instance of an efficient tie between multiple-player groups! Interestingly, the average payoff per player in tied games is inversely related to group size: 17.37 for single players, 8.02 for dyads and 5.87 for triads. Examining the pattern of ties in the multiple-player groups reveals a higher fraction of ties that are competitive Nash equilibrium in the 'shared-profit' treatments (26/183=14.2%), than in the 'private-profit' treatments (10/233=4.3%). This difference is significant (by a test of equality of proportions: $Z= 3.48$; $p < 0.05$) indicating again that 'shared-profit' teams are more similar to single players than are 'private-profit' teams.

4. Discussion

In the Bertrand game if firms meet only once and quote their asking price simultaneously and independently (i.e. non-cooperatively), the prices are theoretically expected to equal the marginal cost, even if there are only two firms in the market. In practice, however, firms often interact repeatedly, which may upset the Bertrand outcome (Tirole, 1988). With repeated interaction, a firm must take into account not only current profits but also the potential long-term losses of a price war. These long-term considerations decrease the temptation to cut prices and may possibly enable the competitors to collude in a purely non-cooperative manner to sustain higher prices than predicted by the one-shot model (Tirole, 1988). In fact, Chamberlin (1929) suggested that when the number of firms in the market is small, tacit collusion resulting in the monopoly price is the most likely outcome.

This prediction is based on the simplifying assumption that the competitors operating in the marketplace are unitary players. In reality, however, the competitors often consist of multiple players, and when this is the case the competitors' internal structure, and in particular the possibility of conflicting interests and coordination problems, must be taken into account (Bornstein, 1992, Rapoport and Bornstein, 1987). This is obviously true when the competitors are alliances of firms (Amaldoss et al., 2000). It is also true when the competitors are single firms. Principal-agent theory acknowledges the existence of conflicting interests within firms, but when firms are studied in strategic contexts of competition against other firms they are typically modeled as unitary players. This is also reflected in experimental markets, where firms are commonly represented by individual subjects (Holt, 1995).

The goal of the present study was to investigate whether the market is sensitive to the violation of the unitary player assumption. Toward this goal, we modeled the competitors in a duopolistic market either as individuals or as teams. We also varied the profit-sharing arrangements of the competing teams, so that in one treatment each team member was paid his or her asking price, while in the other treatment the team's profit was divided equally among its members.

The iterated market in our experiment rendered tacit collusion between the two competitors both theoretically possible and practically viable. Nonetheless, we found that individual players were much better able to collude than teams. Individuals managed to keep the average winning price above 13 points (out of the maximum of 25) as compared with an average winning price of about 8 points in markets consisting of two-person teams, and 6.5 points in competitions between three-person teams. Moreover, in competition between individuals prices increased with practice and, toward the end of the game, the collusive outcome was achieved in a substantial number of cases, whereas in competition between teams prices remained stable, and there was little evidence of learning to collude. Clearly, duopolistic markets are highly sensitive to violations of the unitary player assumption, and collusion is much less likely when the competitors are multi-player teams rather than individuals. This is obviously good news from the consumer's point of view. Collusion resulting in high prices is typically considered socially undesirable, as reflected in antitrust policies.

We also found that profit-sharing arrangements within the competing teams had an effect on the market. Similarly to Bornstein and Gneezy (2002), we found that prices were sustained at a higher level when each team member was paid his or her own asking price than when the team's profits were divided equally. Thus, unlike competition between agents, which lowers prices (Dufwenberg & Gneezy, 2000), competition *within* agents maintains prices at a higher level (at least in this type of competition).

The present study focused on the symmetric situation where the competing agents were either individuals or teams of equal size and identical profit-sharing arrangements. It might be interesting to study asymmetric or "mixed" markets consisting of individuals and teams with different profit-sharing arrangements to find out which type of agent (if any) has a decisive effect on the market's behavior.

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Appendix

Group treatments

Instructions: You are about to participate in a decision-making experiment. During the experiment you will be asked to make a large number of decisions, and so will the other participants. Your own decisions, as well as the decisions of the others, will determine your monetary payoff according to rules that will be explained shortly.

You will be paid in cash at the end of the experiment exactly according to the rules. Please maintain silence throughout the entire experiment and do not communicate in any way with the other participants.

The experiment is computerized. You will make all your decisions by entering the information in the specified locations on the screen. There are 12 people in this experiment, which consists of a large number of decision rounds. At the beginning of the first round, the 12 participants will be divided randomly into four (six) groups of three (two) persons each, and each group will be paired with another group. The pairing will be done randomly by the computer. The composition and the matching of groups will remain constant throughout the experiment. You have no way of knowing who belongs to your group and who belongs to the other group.

At the beginning of a round each of you can ask for any number of points between 2 and 25. After all the participants have entered their requests, the computer will sum up the number of points requested by the three (two) members of your group and will compare it with the total number of points requested by the three (two) members of the other group.

1. If the total request made by your group is **lower** than that made by the other group, each member of your group will receive the number of points he or she requested.

2. If the total request made by your group is **higher** than that made by the other group, each member of your group will receive nothing (0 points).

3. If the total request made by your group is **equal** to that made by the other group, each member of both groups will receive half the number of points he or she requested.

At the end of each round you will receive information concerning (a) the total number of points requested by your group; (b) the total number of points requested by the other group; (c) the number of points you earned on that round; and (d) your cumulative earnings up to this point. We will then move to the next round. At the end of the experiment the computer will count the total number of points you have earned and we will pay you in cash at a rate of 10 points = NIS 1.

After reading the instructions, the participants answered a quiz with three examples. Each example listed the number of points requested by each of the six players and the participants were asked to fill in the earning for each player. The experimenter went over the examples and explained the payoff rules until they were fully understood.

The instructions for the **cooperative** treatment were identical except for the following changes in the payoff rules:

1. If the total request made by your group is **lower** than that made by the other group, each member of your group will receive 1/3 (1/2) of the group's total request. In other words, the total number of points requested by the group will be divided equally among the three (two) group members.

2. If the total request made by your group is **higher** than that made by the other group, each member of your group will receive nothing (0 points).

3. If the total request made by your group is **equal** to that made by the other group, each member of both groups will receive 1/6 (1/4) of the group's total request. In other words, the total number of points demanded by the group will be divided by two and then divided equally among the three (two) group members.

The instructions for the **individual** treatment were identical except for the following changes:

There are 12 people in this experiment, which consists of a large number of decision rounds. At the beginning of the first round, each of the 12 participants will be paired with another participant. The pairing will be done randomly by the computer and will remain constant throughout the experiment. You have no way of knowing whom you are matched with.

At the beginning of a round each of you can request any number of points between 2 and 25. After all the participants have entered their requests, the computer will compare the number of points you requested with the number of points requested by the participant you are matched with.

1. If your request is **lower** than that made by the other participant, you will receive the number of points you requested.

2. If your request is **higher** than that made by the other participant, you will receive nothing (0 points).

3. If your request is **equal** to that made by the other participant, both of you will receive half the number of points you requested.

At the end of each round you will receive information concerning (a) the number of points you requested; (b) the number of points the other participant requested; (c) the number of points you earned on that round; and (d) your cumulative earnings up to this point.

Table 1: Experimental Design

	Team size		
Profit-sharing arrangement	**1**	**2**	**3**
Shared profit	—	12 obs. (48 subjects)	12 obs. (72 subjects)
Private Profit	—	12 obs. (48 subjects)	12 obs. (72 subjects)
	12 obs. (24 subjects)	—	—

Table 2: Mean Asking Price (AP) and Mean Winning Price (MW) of the Five Treatments across 100 Rounds (Mean Ranks in Parenthesis)

		Team size		
Profit-sharing arrangement		**1**	**2**	**3**
Shared Profit:	**AP:** **WP:**	–	9.62 (29.50) 7.79 (28.92)	7.26 (20.50) 5.79 (20.25)
Private Profit	**AP:** **WP:**	–	9.75 (31.58) 8.42 (32.17)	8.29 (24.33) 7.35 (26.58)
Overall	**AP:** **WP:**	15.45 (46.58) 13.55 (44.58)	9.69 8.11	7.78 6.57

Table 3: Mean Rank Correlation (Proportion of Positive Correlations) - Mean Asking Price and Winning price.

	Profit sharing arrangement		
Number of players	Shared	Private	Mean
1	-----	-----	0.15 (8/12) 0.23* (8/12)
2	-0.28* (3/12) -0.16 (3/12)	0.02 (8/12) 0.05 (8/12)	-0.13 (11/24) -0.06 (11/24)
3	-0.10 (3/12) -0.12 (4/12)	0.19 (9/12) 0.20 (9/12)	0.05 (12/24) 0.04 (13/24)
Mean	-0.19* (6/24) -0.14 (7/24)	0.11 (17/24) 0.13 (17/24)	

Note: * mean correlation significantly different from 0 by a Wilcoxon test (p<0.05).

Table 4: Distribution of Values of Tied Games in the Five Treatments

		Tied at		
Type of player	**Number of Ties**	**2 (Nash equilibrium)**	**2 < Price < 25**	**25 (Efficient outcome)**
Individual	441	22%	21%	57%
Private profit team of 2	118	1%	99%	0
Shared profit team of 2	111	17%	83%	0
Private profit team of 3	115	8%	92%	0
Shared profit team of 3	72	10%	90%	0

Figure 1a: Mean Asking Price

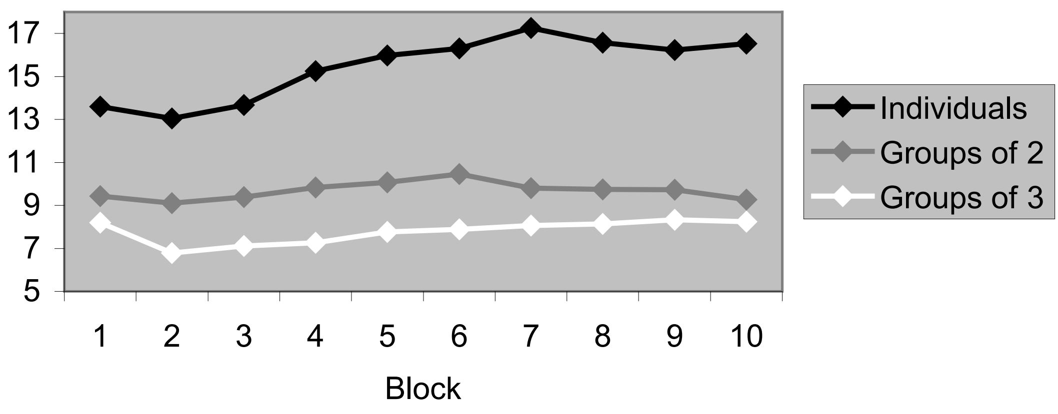
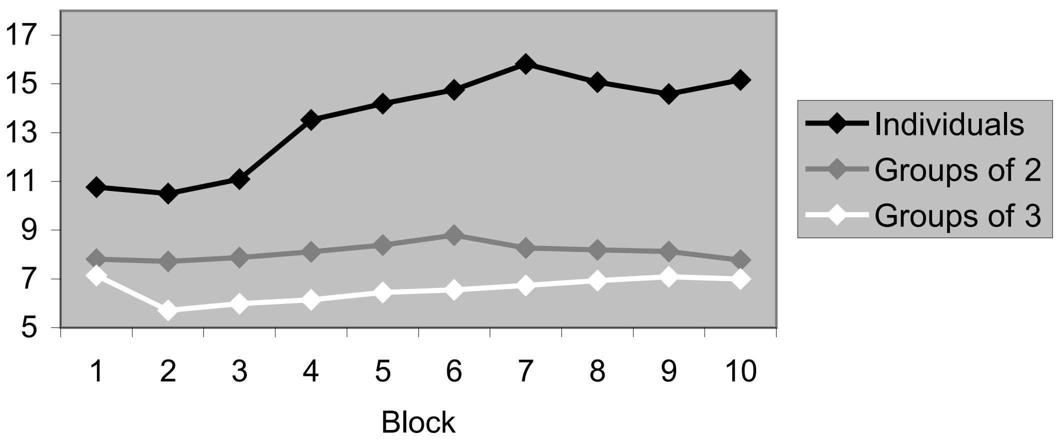


Figure 1b: Mean Winning Price



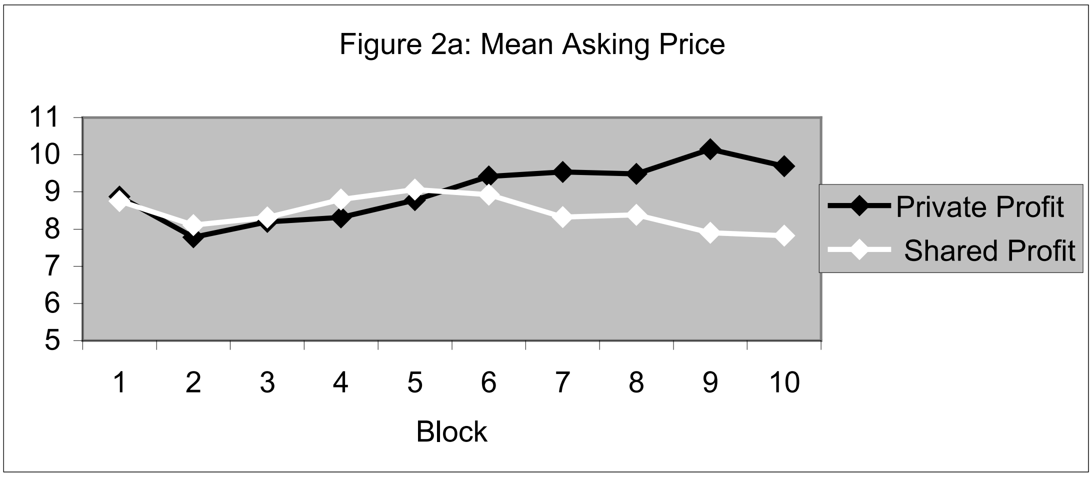


Figure 2a: Mean Asking Price
11
10
9
8
7
6
5
1
2
3
4
5
6
7
8
9
10
Block
Private Profit
Shared Profit

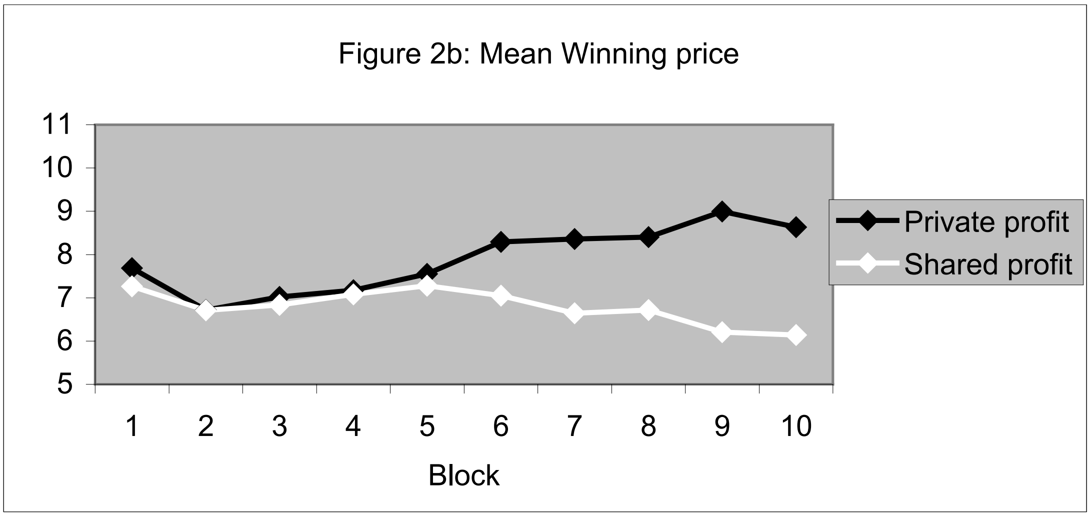


Figure 2b: Mean Winning price
11
10
9
8
7
6
5
1
2
3
4
5
6
7
8
9
10
Block
Private profit
Shared profit