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Altruism and Performance in Bertrand-
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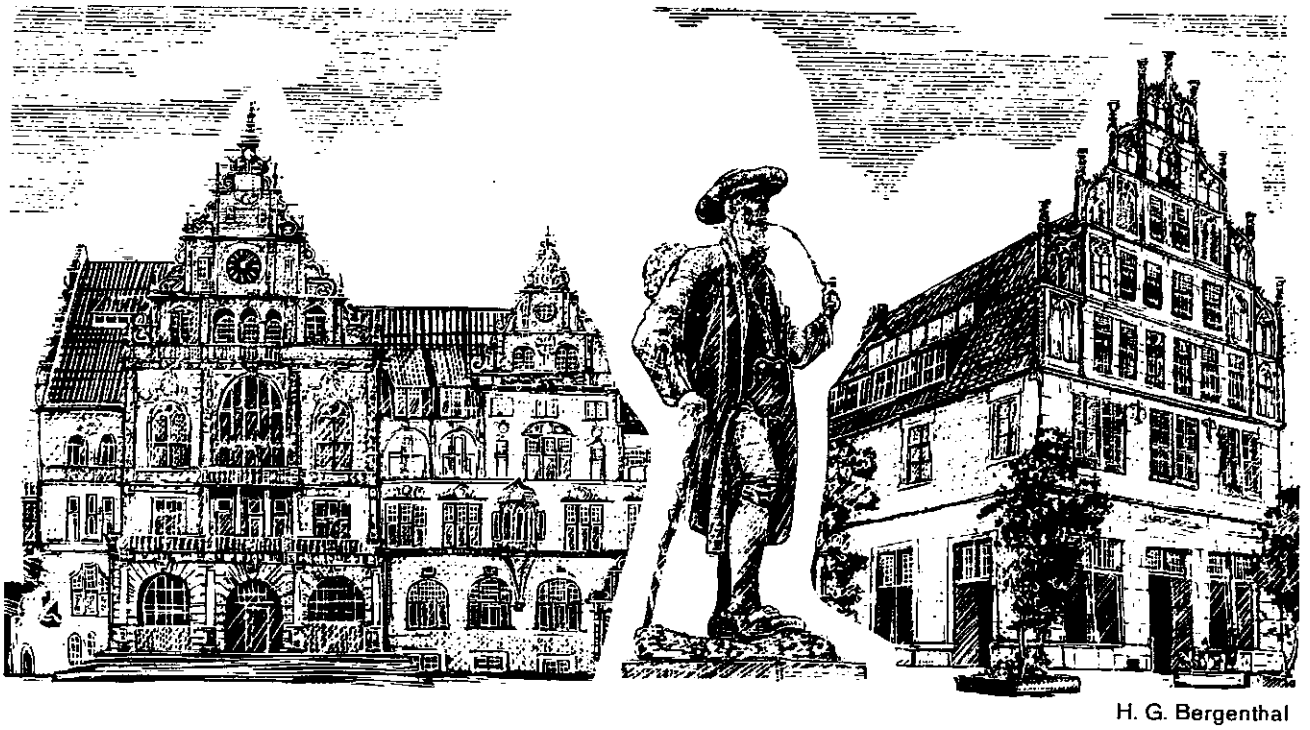

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Altruism and Performance in Bertrand-Duopoly-Experiments[1)]

It is the purpose of this paper to report some results of duopoly experiments which were held in the years 1975 and 1976 at the university of Bielefeld, Federal Republic of Germany. The subjects were economics students. It was one of the aims of these experiments to show that there is a statistically significant relationship between a seperately measured "altruism index" and the performance in the duopoly experiments. In the literature we find that "..personality measures, including risk attitudes, have been disappointing predictors of cooperation in iterated experimental games"[2)].

Before and after the duopoly experiments the subjects had to rank 15 payoff pairs which gave different amounts of money to the subject and an anonymous counterpart. The altruism index has been constructed on the basis of these rankings. The following four hypotheses on the connection of duopoly behavior with the altruism measure have been investigated:

H_1: The joint profit of a duopoly market depends positively on the sum of the altruism indices of both subjects.

H_2: A subject with a higher altruism index than that of his opponent in a duopoly market tends to have a lower profit than his opponent.

H_3: Subjects with a higher altruism index will show a stronger tendency to choose higher prices in the first trial of each run.

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1) The author thanks Prof.Dr.Reinhard Selten for his advise.

2) see: Roger Sherman, Oligopoly, An Empirical Approach, Lexington Books D.C.Heath and Company, Lexington, Massachusetts, Toronto 1972, p. 10.

H_4: Toward the end of the trials of a duopoly market, the subjects with lower altruism indices tend to deviate sooner from the Pareto-optimal solution.

I. The model

The duopoly experiments are based on the Bertrand price variation model with fixed costs and unlimited capacities. In the model of Bertrand[3] the producer who quotes the lowest price gets all the sales, while the other producers make a loss according to their fixed costs[4]. In a duopoly market positive profits for both producers cannot result unless both of them choose the same price. If there were only two possible prices, the game would reduce to a 2x2 prisoner's dilemma bimatrix game like the example given below[5]:

TABLE I

Bimatrix example

		price quotation by producer B: 7.5	price quotation by producer B: 6.0
price quotation by producer A	7.5	95 / 95	-50 / 160
	6.0	160 / -50	70 / 70

The figures in the upper left hand corner of a box are A's rewards.

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3) Joseph Bertrand, Review of Cournot's "Recherches sur les principes mathématiques de la théorie des richesse", Journal des Savants, Vol LXVIII, Sept. 1883, p 499-508

4) similar experiments were performed by:
L.E.Fouraker, S.Siegel, Bargaining Behavior, McGraw Hill New York 1963, and
J.L.Murphy, Effects of the threat of Losses on Duopoly Bargaining, in: The Quarterly Journal of Economics, Vol LXXX

5) See the profit tables "Duopoly sym" in appendix II

In the experiments the subjects could choose between 20 prices, namely all integer multiples of .5 between .5 and 10.0. As can be seen in the profit table for the symetric duopoly market[6], the only equilibrium point is at the price 2.5, with a reward of 0 for both subjects. This is similar to the "Bertrand-price". The maximum joint profit is reached at the price 7.5 (Pareto-optimal solution). Under the assumption, that the opponent chooses such a high price, a subject can maximize his profit by offering the price 6.5. In this case he behaves as "simple maximizer". A simple maximizer is a duopolist who tries to undercut his opponent in order to maximize his profit. If both duopolists behave in this way one can expect a dynamic process, which leads to the Bertrand equilibrium price.

II. The altruism test

The altruism tests were performed before and after the oligopoly market experiments. The subjects had to rank 15 different payoff pairs[7][8]. They received money payoffs determind by their rankings[9].

A theoretical way of generating plausible rankings of the 15 payoff pairs can be derived from a hypothatical goal of maximizing a linear combination of the form $A + \alpha B$, where A is the subject's reward and B is the reward for the anonymous counterpart ($A + \alpha B \Longrightarrow \max$). Since small differences of α have little influence on the ranking, theoretical rankings have been computet for four representative values of α only. The results of the test suggest that values of α greater than one need not be considered. Nobody seems to attach more

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6) Profit table "Duopoly sym" in appendix II
7) For complete instructions see appendix I
8) At the "Fifth Research Conference on Subjective Probability, Utility and Decision Making" at Darmstadt, Sept. 1-4, 1975 J.Grzelak, T.Iwinski, J.Radzicki, University of Warsaw reportet about similar tests.

9) For the exact payoff scheme see the instructions, appendix I.

importance to the other subject's payoff than to his own. Obvious interpretations in terms of altruism, egoism and rivalism can be given to the four values of α considered here:

1. $A + 1 \cdot B \Rightarrow \max$ (altruistic attitude)
   The subject wants to maximize joint profit.

2. $A + .5 \cdot B \Rightarrow \max$ (intermediate attitude)
   The subject considers the other subject's interests but only half as much as his own interests.

3. $A + 0 \cdot B \Rightarrow \max$ (egoistic attitude)
   The subject wants to maximize his own reward.

4. $A - 1 \cdot B \Rightarrow \max$ (rivalistic attitude)
   The subject wants to maximize the difference between his own payoff and that of his opponent.

Table II gives an impression of the correlation between the four theoretical rankings[10].

TABLE II

Correlation between the theoretical rankings

	1.	2.	3.	4.
1. $A + 1 \cdot B \Rightarrow \max$	1	.78	.53	-.04
2. $A + .5 \cdot B \Rightarrow \max$	.78	1	.92	.57
3. $A + 0 \cdot B \Rightarrow \max$	.53	.92	1	.81
4. $A - 1 \cdot B \Rightarrow \max$	-.04	.57	.81	1

III. Procedure

The necessary amount of time for the whole experiment was 9 hours. Therefore two afternoon sessions of 4.5 hours each had to be held. The experiments were performed at the university of Bielefeld. The subjects were 36 economics students, 35 males

10) The values are Spearman rank correlation coefficients

and one female.
Each subject took part in 5 runs of oligopoly experiments. The first three runs were duopolies with symmetric and asymmetric structures[11]. In the fourth and fifth run some subjects played duopoly games whereas others played higher oligopolies. The subjects had complete information in the sense that they knew the profit tables of their counterpart and their opponent's price choice of the previous trial. The first run began with 3 practice trials, followed by 20 regular trials. The other four runs had 10 regular trials. At the end of each run the subjects received money payoffs according to their profits[12].
Totally an amount of DM 1.512.60 (including DM 160.10 for the altruism tests) was payed to the 36 subjects[13]. The highest amount payed to a subject was DM 72.30 and the lowest amount was DM 19.65.
Before the start of the experiment each subject had to draw a number, which remained the same for the whole experiment. Altruism tests were performed before and after the 5 oligopoly runs. The subjects were told that they had the same opponents within a run but different opponents in different runs. They were unable to detect their opponents identity. The subjects were placed in a large room, where they could see each other but not talk to each other.

IV. Results of the altruism test

One might wish to evaluate the altruism test by fitting an α for each subject (see section II). In principle this is possible but one receives a measure, which does not differentiate sufficiently well between the subjects. Later we shall introduce a different measure of altruism. Nevertheless it is instructive to group the subjects according to their nearness to one of the four theoretical rankings with $\alpha = 1$, $\alpha = .5$, $\alpha = 0$, $\alpha = -1$. The following condition for grouping a subject

11) see profit tables in appendix II
12) For the exact payment scheme see instructions in appendix II
13) Some additional money was payed for a risk taking test which will not be described here.

into one of the four categories was adopted: the subject's ranking and the theoretical ranking must have a Spearman rank correlation coefficient of at least .77 (this corresponds to a level of significance $p < .001$, two-sided). If there were several correlations of at least .77 with one of the four theoretical rankings, the group was selected in accordance with the highest of these correlations.

Table 3 shows the results. The number of rankings where the Spearman correlation coefficient with the theoretical ranking is 1.00, is given in brackets. The group "not attachable" contains those subjects which could not be grouped with one of the theoretical rankings according to our criterion. There were some rankings whose correlations with the theoretical rankings were very low or negative. Partly this is due to misunderstanding and to erratic behavior, but in some cases motivations like equal split ($|A - B| \Rightarrow \min$) or product maximization ($A \cdot B \Rightarrow \max$) seem to explain the subject's behavior.

TABLE III

Correlations to the theoretical rankings

		1st test	2nd test
altruistic attitude	$\alpha = 1$	8 (3)	11 (5)
intermediate attitude	$\alpha = .5$	8 (0)	9 (0)
egoistic attitude	$\alpha = 0$	10 (2)	10 (7)
rivalistic attitude	$\alpha = -1$	0 (0)	2 (0)
not attachable		10	4

The results suggest that subjects understood the test better, when they had to do it for the second time. They showed a more systematic behavior. The group of "not attachable" diminished from 10 to 4 and the number of subjects with correlation coefficients of 1.00 increased from 5 to 12.

Even if it does not show in the table 3, rivalistic motivations are not completely unimportant. In order to see this, we look at the following four of the 15 payoff pairs:

1.) A = 70; B = 160 3.) A = 40; B = 170
2.) A = 60; B = 30 4.) A = 30; B = 50

In the first test 8 of 36 subjects prefered pair 2 to pair 1 or pair 4 to pair 3. In the second test the number of such subjects dropped to 3.

A convenient way to measure altruistic tendencies can be based on the Spearman rank correlation coefficients between a subject's ranking and the theoretical ranking corresponding to $\alpha = 1$ (altruistic attitude). The symbols r_1 and r_2 will be used in order to denote these correlation coefficients for the first and the second test respectively.
R_1, R_2 and R are the ranks of r_1, r_2 and r_1+r_2 respectively computet for the group of all 36 subjects. R_1, R_2 and R are rankings from above, i.e. the most altruistic subject receives rank 1. We shall refer to these numbers as "altruism ranks".

The experience gained at the oligopoly experiments does not seem to have a statistically significant influence on the behavior in the second altruism test. There are a few cases were subjects made poor profits in the oligopoly experiments and behaved less altruistically in the second test, but there is also a number of subjects with very high profits achieved by cooperation, who behaved less altruistically in the second test and vice versa. Table 4 gives the results of the first and the second altruism test (r_1 and r_2), the altruism ranks R_1, R_2 and R and the total profits gained in the oligopoly experiments.
Table 4 also shows the Spearman rank correlation r_{12} between each subject's first and second ranking. Generally these correlations are quite high (the median of r_{12} is at .87).
The Spearman rank correlation coefficient between the altruism ranks R_1 and R_2 is .671 (this corresponds to a level of significance $p < .001$, two-sided).
Only r_1 can be considered as independent of the experience

TABLE IV

Correlation coefficiants*, altruism ranks and total profits

No	correlation coefficiants		correlation between 1st and 2nd test	altruism ranks			total profits	
	r_1	r_2	r_{12}	R_1	R_2	R	first session	second session
1	0.75	0.99	0.76	12	6	8	22.55	10.55
2	0.78	0.67	0.89	10	20	17	16.50	12.25
3	0.09	0.53	0.17	34	28	31	12.70	22.30
4	0.86	0.99	0.88	7	7.5	6	11.90	18.10
5	0.99	1.00	0.99	4.5	3	2.5	7.00	23.30
6	0.82	0.53	0.62	8	28	19	18.55	8.85
7	0.72	0.81	0.87	14	14	12	31.95	29.00
8	1.00	0.92	0.92	2	11	5	17.40	23.15
9	0.51	0.51	0.85	27	32	26	17.95	11.40
10	0.68	0.85	0.91	17	12	14	17.60	29.20
11	0.42	0.11	0.83	29.5	34	33	13.75	23.25
12	0.45	0.41	0.92	28	33	29	20.40	35.20
13	0.81	0.74	0.90	9	16	13	16.10	20.55
14	0.67	0.72	0.91	18	18	18	5.80	36.60
15	0.56	1.00	0.56	22	3	11	27.30	5.20
16	0.74	0.77	0.83	13	15	16	33.90	32.75
17	0.42	0.59	0.66	29.5	23	27	24.90	11.45
18	0.64	0.66	0.96	19	21	21	17.40	27.10
19	0.53	0.53	1.00	25.5	28	25	9.05	7.80
20	0.59	0.73	0.93	21	17	20	16.05	23.45
21	1.00	0.84	0.84	2	13	7	25.05	22.70
22	0.68	0.97	0.77	15.5	9	10	22.60	14.00
23	0.75	0.99	0.76	11	7.5	9	27.60	22.10
24	0.16	0.61	0.34	33	22	30	14.10	14.10
25	0.06	0.53	0.45	35	28	32	15.10	20.65
26	-0.29	0.53	-0.29	36	28	36	21.75	18.50
27	0.26	0.05	0.95	32	35	35	5.25	17.10
28	1.00	1.00	1.00	2	3	1	13.90	21.65
29	0.99	1.00	0.99	4.5	3	2.5	15.65	17.40
30	0.53	0.97	0.47	25.5	10	15	15.85	21.65
31	0.68	-0.09	0.14	15.5	36	34	7.65	25.70
32	0.62	0.68	0.98	20	19	22	10.65	19.20
33	0.98	1.00	0.98	6	3	4	16.85	24.50
34	0.55	0.53	0.99	23.5	28	24	12.30	20.55
35	0.38	0.53	0.63	31	28	28	23.25	22.70
36	0.55	0.58	0.96	23.5	24	23	13.50	18.75

* Spearman rank correlation coefficiants between the subject's ranking in the first test (r_1) or the second test (r_2) with the theoretical ranking corresponding to $\alpha = 1$ (altruistic attitude).

gained in the oligopoly runs. Nevertheless it seems to be better to test our hypotheses with the help of r_1+r_2 rather than r_1, since r_1+r_2 yields a sharper distinction between the subjects. It seems to be wasteful to neglect the information supplied by r_2. We call r_1+r_2 the "altruism index" of a subject.

V. Examination of the four hypotheses.

H_1: The joint profit of a duopoly market depends positively on the sum of the altruism indices of both subjects.

In order to test this hypothesis duopoly runs with different structures must be investigated seperately. Moreover it is useful to group the data according to runs in order to avoid distortions caused by learning effects. The runs 4 and 5 were grouped together, because the number of duopoly markets is smaller in these runs. Moreover no learning effects can be observed from run 4 to 5. In this way one obtains 11 groups with 6 markets and 1 group with 2 markets (duopoly sym, runs 4 and 5).

For every group the Spearman rank correlation coefficient between the sum of altruism ranks R of both subjects and their joint profits is shown in table 5.

TABLE V

Correlation between altruism ranks and joint profits

	RUN			
structures	1	2	3	4 and 5
duopoly sym	.114	.200	.257	1.000
duopoly asym I	.457	.600	.486	.771
duopoly asym II	1.000	-.600	.314	-.857

Ten of the twelve correlation coefficients in table 5 are positive. The null hypothesis of the binomial test can be rejected at the level of significance of .02 (one-sided).

A possible explanation of the two negative correlation coefficients can be seen in the properties of these cases. In the duopolies with the structure asym II the subject's profits are equal if they choose the same price, but with respect to undercutting subject A is in a better position. Player A's monopoly price is at 5.0 wheras B's monopoly price is at 7.0[14]. Unlike player A player B cannot hope to get substantial profits if the players begin to undercut each other. Therefore A's undercutting will motivate B to choose the relatively secure position of the equilibrium price. Since this result is very undesirable for player A he will avoid undercutting, even if he is not altruistic.

H_2: <u>A subject with a higher altruism index (r_1+r_2) than that of his opponent in a duopoly market tends to have a lower profit than his opponent</u>.

This hypothesis is supported by 37 of 62 cases. The null hypothesis of the binomial test cannot be rejected. Nevertheless a closer look at the data shows that a modified version of the hypothesis is not without justification. Not only the sign but also the size of the difference between the two altruism ranks seems to be important.
Therefore a Mann-Whitney-U-Test is performed testing the assumption that H_2 will have a higher probability of beeing supported the greater the difference between the altruism ranks is. The null hypothesis of the U-test can be rejected at the $p < .006$ level of significance ($U=296$, $n_1=27$, $n_2=35$, one-sided).

Table 6 gives an impression of the results with regard to H_2. The table shows the number of cases for and against H_2 grouped with respect to altruism rank difference, market structure and runs. Under the assumption that only a sufficiently great difference in the altruism ranks R has an influence on differences of behavior in the market, the second group can be

14) see profit table "asym II" in appendix II.

TABLE VI

Number of cases for and against H_2

market structure		RUN 1 +	RUN 1 −	RUN 2 +	RUN 2 −	RUN 3 +	RUN 3 −	RUN 4 +	RUN 4 −	RUN 5 +	RUN 5 −	total +	total −
difference < 10	sym	1	2	3	1	-	4	-	1	-	-	4	8
	asym I	1	-	-	1	-	1	1	-	-	3	2	5
	asym II	2	1	1	-	-	1	-	-	-	1	3	3
total		4	3	4	2	0	6	1	1	0	4	9	16
difference ≥ 10	sym	1	2	2	-	1	-	-	-	1	-	5	2
	asym I	4	1	5	-	3	2	1	1	-	-	13	4
	asym II	1	1	3	-	1	2	1	2	2	-	8	5
total		6	4	10	0	5	4	2	3	3	0	26	11

examined seperately with the help of a binomial test. Out of 37 cases, 11 are against H_2, which corresponds to a .01 level of significance (one-sided).

The results of the market experiment show that in the last three runs the subject's behavior stabilizes on the Pareto-optimal solution. There the differences between profits depend in most cases on the behavior in the last trials ("end effects"). In connection with the investigation of H_4 it will be shown that there is no significant relationship between the altruism rank of a subject and the behavior in the last trials. Consequently we cannot expect a connection between altruism ranks and profits in the last three runs. Therefore the two first runs have been investigated seperately. For all cases of the first two runs the binomial test yields a .007 level of significance (one-sided).

H_3: Subjects with a higher altruism index will show a stronger tendency to choose higher prices in the first trial of each run.

This hypothesis is examined in two versions:

H_3^1: Subjects with a higher altruism rank r_i will choose a higher price in the first trial of the first run.

To test H_3^1 each subject's opening price in the first run gets a rank according to the closeness to the Pareto price. This price rank is compaired with R_1 (see table 4). Compairing both rows yields a Spearman rank correlation coefficient $r = .402$. We can reject the null hypothesis at the $p < .01$ level of significance (one-sided).

H_3^2: Subjects with a higher altruism index r_1+r_2 will choose higher prices in the first trial of each run.

To test H_3^2 the sum of each subject's opening prices is computet. The greater this sum, the higher the rank. This price rank is compaired with the altruism rank R. One receives a Spearman rank correlation coefficient $r = .435$; the null hypothesis must be rejected at the .005 level (one sided).

The relationship between altruism rank and opening price has been testet, because the opening price seems to have a great influence on the "attainment of cooperation". To eliminate start- and end effects the "attainment of cooperation" is defined by the following condition: booth market participants choose the Pareto price for at least 4 successive trials. Table 7 shows the influence of the opening price on the attainment of cooperation.

TABLE VII

Opening price and the attainment of cooperation

	attainment of cooperation	no attainment of cooperation
both choose Pareto price	23	1
one chooses Pareto price	11	16
no one chooses Pareto price	2	15

The results of table 7 are examined with the help of a χ^2-test. With $\chi^2 = 30.88$ the null hypothesis can be rejectet at the .001 level of significance (two-sided, $\chi^2 = 13.82$).

H_4: Toward the end of the trials of a duopoly market, the subjects with lower altruism indices r_1+r_2 tend to deviate sooner from the Pareto-optimal solution.

To test this hypothesis, only those runs are examined, where cooperation had been attained (according the definition for table 7) and the opponent had not left the Pareto price earlier than the subject. The end effect is measured in the following way: If a subject chooses the Pareto price also in the last trial, his value for this run is "0". If he deviates from the Pareto price in the last trial, his value is "1" etc. The sum of these values is computet for each subject and devided by the number of cases. This "average-end-effect-value" is compaired with the values of the other subjects. The smaller this value, the higher is the rank. The comparison of these ranks with the altruism rank R for every subject yields a Spearman rank correlation coefficient r = .188. Apparently there is no significant relationship between the altruism index r_1+r_2 of a subject and the performance in the last trials of a duopoly experiment.
Looking at the results induces the conjecture that other factors have a greater influence on the end effect, as e.g. experiences in previous runs, the opponent's behavior during this run and the relation between realized profits, expected profits and opponent's profits.

VI. Conclusions

In non-cooperative duopoly market experiments, where price bids are the only comunication between the two market participants, the subject's attitudes have a great influence on performance. It can be shown that there is a significant

positive relationship between the joint profit of a duopoly market and the level of altruism of both subjects. A less altruistic subject receives a higher reward than the other one. It turned out that the price chosen in the first trial of a run has a strong influence on the attainment of cooperation. This opening price is strongly influenced by a subject's attitude towards altruism. The more altruistic a subject is, the more tends his opening price to the Pareto price. The performance at the end of a duopoly market experiment (end effect) is much more influenced by other factors than by a subject's attitudes towards altruism.

Appendix I

ALTRUISM TEST

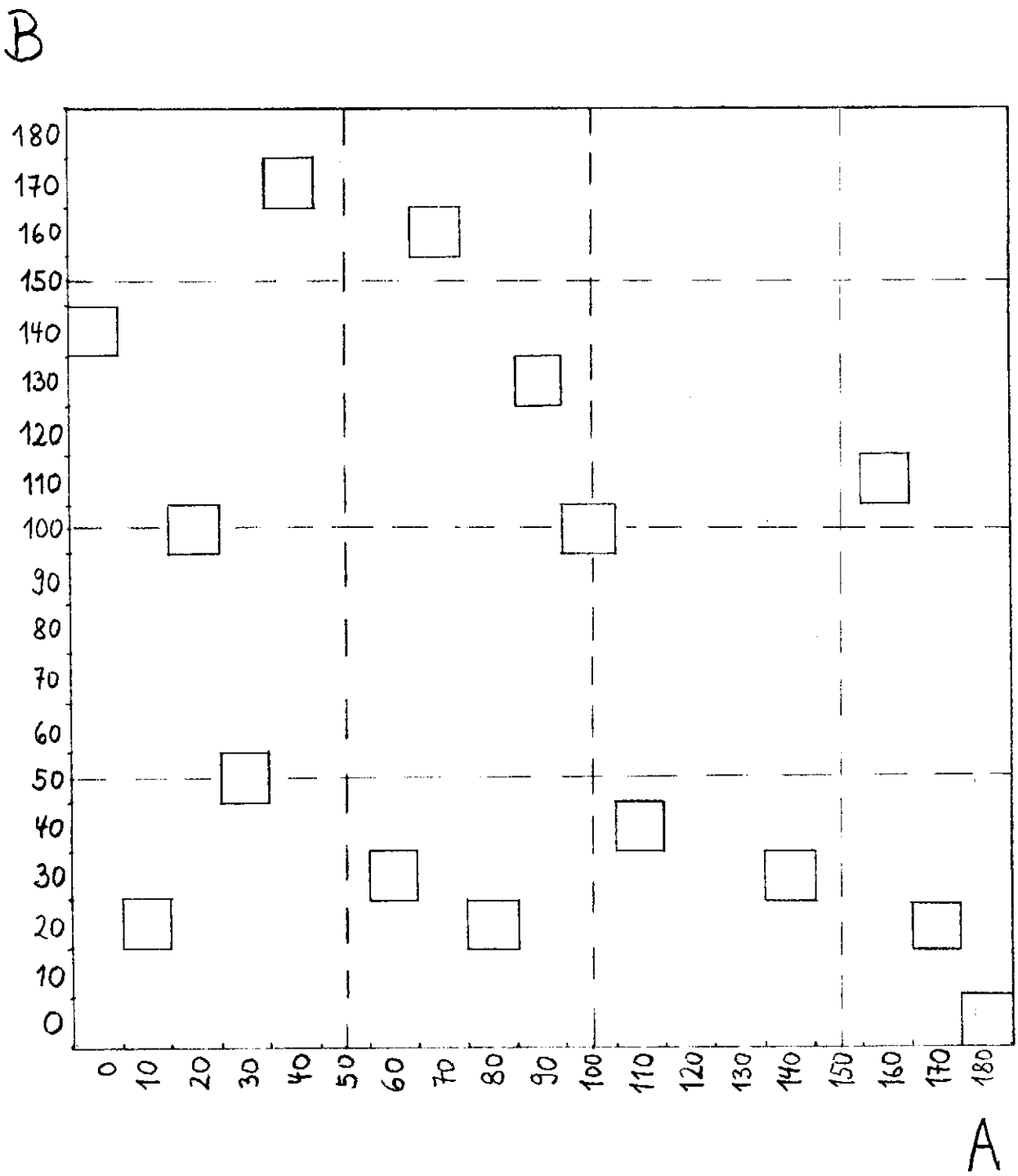
Instructions (translated from German)

1. You have to rank 15 payoff pairs in order of your preference. On the horizontal line (A) you find the amount of money you can get. You will be paired at random with another person who's corresponding amount can be seen on the vertical line (B).
2. Try to determine your preferences by many comparisons between two payoff pairs, e.g.you (A) get 90 and your counterpart (B) gets 130 or you get 110 and your counterpart gets 40.
3. Do this until you get 15 different ranking numbers (1 for the best payoff pair). Write those numbers in the corresponding boxes.
4. After everybody has done so, the sheets are collected. An experimental assistant draws at random 3 out of the 15 possible payoff pairs.
5. You and your anonymous counterpart will get an amount of money according to that one of the 3 pairs to which you have given the highest rank.
6. No one will ever know the identity of his counterpart.
7. You will get the money according to your decision (A) and according to the decision of another anonymous subject, who is different from the person (B), who gets the money according to your ranking.
8. Do the ranking very carefully, as you will be payed in real money.

DECISION SHEET

A: Amount of money for yourself (in Pfg)

B: Amount of money for your anonymous counterpart (in Pfg)



Appendix II

Part of the subject's instruction for the symetric duopoly market (translated from German).

You represent a firm which is engaged in selling some standardized good on a duopoly market. Your profit will therefore be influenced by the behavior of the other subject, who is selling on the same market. You will never know the identity of this other person, nor will he be aware of yours.

You and your anonymous counterpart will engage in a series of trials by means of written price bids. The table at the end of this instruction shows you the various levels of profit or loss you and your opponent can attain, depending on the price set by you and your counterpart.
Make your decisions carefully because they determine, how much money you will earn during the session. It should be your goal to earn as much as possible. It is not important, to get more than your counterpart.

Procedures

1. You will have three practice trials to get accustomed to using the profit table. The next 20 trials determine your earnings.
2. You get DM 5.-- of initial capital to start with.
3. At the beginning of each trial you make a conjecture about your counterpart's price and write it into column I (expected price of the opponent) of the decision sheet.
4. Select your own price for this trial and write it into column II (own price).
5. The decision sheet will be collected and the opponent's price is entered in column III by an experimental assistant.
6. After the decision sheet is returned to you, you compute your profit or loss according to the profit table and write it into column IV (own profit).
7. Now the process starts again by making a conjecture about your counterpart's price and than selecting your own price etc.

8. After the 20th trial you add up your profit column. We will pay you your earnings together with your initial capital. Nobody will see, how much money you get. If the sum of initial capital and total profits is negative, you will get nothing and you will have to pay nothing.
9. You are not permitted to talk with any other subject during the experiment.

PROFIT TABLE

Duopoly sym

Profit per trial (in German Pfennig), depending on the price P set by you and the price CP set by your counterpart. There are three situations:

- You have the lower price (P < CP)
- You are tied for low price (P = CP)
- You have the higher price (P > CP)

Your price	Your profit P < CP	P = CP	P > CP
0.5	- 15	- 40	
1.0	- 10	- 30	- 50
1.5	- 5	- 20	- 50
2.0	0	- 10	- 50
2.5	20	0	- 50
3.0	40	10	- 50
3.5	60	20	- 50
4.0	80	30	- 50
4.5	100	40	- 50
5.0	120	50	- 50
5.5	140	60	- 50
6.0	160	70	- 50
6.5	165	80	- 50
7.0	160	90	- 50
7.5	140	95	- 50
8.0	120	90	- 50
8.5	100	80	- 50
9.0	80	70	- 50
9.5	60	60	- 50
10.0		50	- 50

Initial capital: 500

PROFIT TABLE

Duopoly asym I A

Profit per trial (in German Pfennig), depending on the price P set by you and the price CP set by your counterpart. There are three situations:

- You have the lower price (P < CP)
- You are tied for low price (P = CP)
- You have the higher price (P > CP)

Your price	Your profit			Your counterpart's profit		
	P < CP	P = CP	P > CP	P > CP	P = CP	P < CP
0.5	- 10	- 30		- 25	- 45	
1.0	- 5	- 20	- 50	- 20	- 40	- 50
1.5	5	- 10	- 50	- 15	- 35	- 50
2.0	15	0	- 50	- 10	- 30	- 50
2.5	25	10	- 50	- 5	- 20	- 50
3.0	30	20	- 50	0	- 10	- 50
3.5	70	30	- 50	20	0	- 50
4.0	100	40	- 50	40	10	- 50
4.5	120	50	- 50	60	20	- 50
5.0	140	60	- 50	80	30	- 50
5.5	160	70	- 50	100	40	- 50
6.0	165	80	- 50	120	50	- 50
6.5	160	90	- 50	140	60	- 50
7.0	140	95	- 50	160	70	- 50
7.5	120	90	- 50	165	80	- 50
8.0	100	80	- 50	160	90	- 50
8.5	80	70	- 50	140	95	- 50
9.0	60	60	- 50	120	90	- 50
9.5	40	50	- 50	100	80	- 50
10.0		40	- 50		70	- 50

Your initial capital: 250

Your counterpart's initial capital: 500

PROFIT TABLE

Duopoly asym II A

Profit per trial (in German Pfennig), depending on the price P set by you and the price CP set by your counterpart. There are three situations:

- You have the lower price (P < CP)
- You are tied for low price (P = CP)
- You have the higher price (P > CP)

your price	your profit			Your counterpart's profit		
	P < CP	P = CP	P > CP	P > CP	P = CP	P < CP
0.5	- 15	- 40		- 10	- 40	
1.0	- 10	- 30	- 50	- 5	- 30	- 50
1.5	- 5	- 20	- 50	0	- 20	- 50
2.0	5	- 10	- 50	5	- 10	- 50
2.5	10	0	- 50	10	0	- 50
3.0	40	10	- 50	25	10	- 50
3.5	65	20	- 50	40	20	- 50
4.0	95	30	- 50	50	30	- 50
4.5	130	40	- 50	70	40	- 50
5.0	165	50	- 50	90	50	- 50
5.5	140	60	- 50	110	60	- 50
6.0	130	70	- 50	130	70	- 50
6.5	120	80	- 50	160	80	- 50
7.0	110	90	- 50	165	90	- 50
7.5	100	95	- 50	150	95	- 50
8.0	90	90	- 50	130	90	- 50
8.5	80	80	- 50	110	80	- 50
9.0	70	70	- 50	90	70	- 50
9.5	60	60	- 50	70	60	- 50
10.0		50	- 50		50	- 50

Your initial capital: 500

Your counterpart's initial capital: 500