Economics
The Open-Access, Open-Assessment E-Journal

Vol. 7, 2013-20 | May 08, 2013 | http://dx.doi.org/10.5018/economics-ejournal.ja.2013-20

Is a "Firm" a Firm? A Stackelberg Experiment

Andreas Hildenbrand

Abstract
Industrial organization is mainly concerned with the behavior of large firms, especially when it comes to oligopoly theory. Experimental industrial organization, therefore, faces a problem: How can firms be brought into the laboratory? The main approach relies on framing: Call individuals "firms"! This experimental approach is not in line with modern industrial organization, according to which a firm's market behavior is also determined by its organizational structure. In this paper, a Stackelberg experiment is considered in order to answer the question whether framing individual decision making as firm decision making or implementing an organizational structure is more effective for generating profit-maximizing behavior. Firms are either represented by individuals or by teams. Teams are organized according to a parsimonious version of Alchian and Demsetz's (Production, Information Costs, and Economic Organization, 1972) contractual model of the firm. The author finds teams' quantity choices are more in line with the assumption of profit maximization than individuals' choices. Compared to individuals, teams appear to be less inequality averse.

JEL C72 C91 C92 D43 L13
Keywords Industrial organization; Stackelberg game; individual behavior; team behavior; framing; experimental economics

Authors
Andreas Hildenbrand, ✉ Institute of Farm and Agribusiness Management, Justus Liebig University Giessen, Germany, andreas.hildenbrand@agrar.uni-giessen.de

Citation Andreas Hildenbrand (2013). Is a "Firm" a Firm? A Stackelberg Experiment. *Economics: The Open-Access, Open-Assessment E-Journal*, Vol. 7, 2013-20. http://dx.doi.org/10.5018/economics-ejournal.ja.2013-20

Received October 1, 2012 **Published as Economics Discussion Paper** October 10, 2012
Revised April 25, 2013 **Accepted** April 26, 2013 **Published** May 8, 2013

1 Introduction

For Tirole (1988, p. 3), industrial organization (IO) "certainly begins with the structure and behavior of firms". So does it for Scherer and Ross (1990, p. 1). Firms are typically assumed to be large, especially when it comes to oligopoly theory (see also Shapiro, 1989). Holmstrom and Tirole (1989) emphasize organizational structure and market behavior are interdependent. Discussing theories of the firm going beyond the neoclassical production function approach, they show how a firm's market behavior is affected by its organizational structure (see also Furubotn and Richter, 2005, pp. 361–469).[1] In these theories, the firm is seen as an organizational structure, a nexus of contracts (contractual view). Nevertheless, in IO, firms are usually treated in the neoclassical way: They are regarded as single decision makers that maximize profits (see, e.g., Tirole, 1988, p. 4; Scherer and Ross, 1990, pp. 38, 52).[2] In the light of the contractual view, the objective of profit maximization can be interpreted as a consequence of the organizational structure transforming individual behavior within the firm into profit maximization on the market.[3] If this view is taken, the question is: What organizational structure, if any, results in profit maximization? This question is of special interest if firms are assumed to be large, because large firms always have a nontrivial organizational structure.

Although firms are particularly assumed to be large in oligopoly theory, a quite different question is posed in most oligopoly experiments: How do individuals behave on an experimental market? The market structure is derived from an oligopoly game. No organizational structure is implemented. Instead, individuals are called "firms" (IO framing). Typically, participants are found to exhibit other-regarding preferences. Therefore, framing individual decision making as firm decision making appears to be ineffective for generating profit-maximizing behavior: An IO framing does not turn individuals into profit maximizers. For example, Huck et al. (2001) proceed in this way. In a Stackelberg experiment (STACKRAND treatment), they examine a market for a homogeneous product on which two firms sequentially compete in quantities.[4] Firms are represented by individuals, and an IO framing is used. They find, on average, leaders choose a lower quantity, and followers choose a higher quantity than predicted by the unique subgame-perfect Nash equilibrium (Stackelberg equilibrium). For the most part, these deviations can be explained by inequality aversion (see Huck et al., 2001, pp. 758–761; Lau and Leung, 2010).[5]

[1] For a presentation of the neoclassical theory of the firm, see Nadiri (1982).

[2] More precisely, firms are assumed to be profit maximizers with rational expectations.

[3] This position is methodologically sound (see Albert and Hildenbrand, 2012).

[4] Huck et al. are regarded as the first to implement a Stackelberg market in the laboratory.

[5] In the recent past, many more experiments of that kind were run (see, e.g., Huck and Wallace, 2002). Often, the standard duopoly games were extended by a pre-play stage in order to endogenize

What is surprising is the fact that it is regularly not controlled for the effect supposed to be triggered by the IO framing: There are no control treatments in which participants are neutrally instructed. Maybe this is because framing is expected to be ineffective (see also Normann and Ruffle, 2011, p. 1). However, if that were expected, there would be no reason for an IO framing at all. If the IO framing is expected to affect individual behavior, two questions arise: First, what does the effect look like? Second, is the effect of framing individual decision making as firm decision making different from the effect of implementing an organizational structure?

Hoffman et al. (1994) give an answer to the first question on the basis of an ultimatum game. Individuals are either called "seller" and "buyer", or they are neutrally instructed. They find proposers offer less under an IO framing than under a neutral framing. Responders reject offers under an IO framing as frequent as under a neutral framing: Rejection rates are the same for both treatments. Thus, at least proposer behavior is directed towards profit maximization.

On the basis of a Stackelberg game, an answer to the second question is given by Müller and Tan (2011).[6] In their Stackelberg experiment, they study a market for a homogeneous product on which two firms sequentially compete in quantities. Firms are either represented by individuals or by three-member teams, and an IO framing is used in both treatments. Team members exchange electronic messages via a chat box in order to come to an unanimous agreement on their collective quantity. They find, on average, individuals or teams in the leader role choose a lower quantity, and individuals or teams in the follower role choose a higher quantity than predicted by the Stackelberg equilibrium. Compared to individuals' quantity choices, teams' choices are not found to be more in line with the assumption of profit maximization. The same answer is given by Raab and Schipper (2009) on the basis of a Cournot game. In their Cournot experiment, they examine a market for a homogeneous product on which three firms simultaneously compete in quantities. Firms are either represented by individuals or by three-member teams, and an IO framing is also used. Individuals directly choose their quantities. Team members simultaneously choose efforts: The quantity of each team is the sum of its members' efforts. They find no difference between the market behavior of individuals and teams. In contrast to Müller and Tan's findings, both individuals' and teams' mean quantity choices are close to the unique Nash equilibrium (Cournot equilibrium) prediction.

the sequence of play. For example, see Huck et al. (2002), Fonseca et al. (2005), Fonseca et al. (2006), and Müller (2006). Hildenbrand (2010) reviews and discusses these experiments.

[6] The first oligopoly experiment taking account of an organizational structure was run by Sauermann and Selten (1959). In contrast to recent experiments, it was more of exploratory nature. More experiments of this kind were published by Selten (1967b,a).

Neither Müller and Tan nor Raab and Schipper find a difference between the market behavior of individuals and teams. However, a difference between the qualities of the predictions emerges: The asymmetric Stackelberg prediction fails for individuals under an IO framing and teams organized according to Müller and Tan's ad-hoc theory of the firm, whereas the symmetric Cournot prediction is corroborated. In other Cournot experiments, individuals' quantity choices are also found to be in line with the assumption of profit maximization (see, e.g., Holt, 1985; Huck et al., 2004).

In other experiments on team decision making, teams are found to behave more in line with the assumption of profit maximization than individuals (see, e.g., Bornstein and Gneezy, 2002; Bornstein et al., 2008). The same is true for many experiments on group decision making, but there are opposite results, too.[7] The term "team" is used if groups of participants collectively represent firms in a market experiment or if participants' collective decisions are framed as firms' decisions. Otherwise, the term "group" is used. For example, in their ultimatum experiment, Bornstein and Yaniv (1998) study a situation in which two players sequentially bargain over the division of a sum of money. Players are either represented by individuals or by three-member groups. Group members have face-to-face discussions to make their collective decision: A specific decision rule is not predetermined by the experimenters. Groups' decisions are found to be more in line with the assumption of profit maximization than individuals' decisions: Groups in the proposer role offer less than individuals in this role, and groups in the responder role are willing to accept less than individuals in that role.

Two central differences between the experiments can be identified in order to explain the mixed results: the organizational structure and the market structure (see also Raab and Schipper, 2009, pp. 698–700). If the market structure is derived from a Cournot game, both individuals and teams appear to be profit maximizers. Their market behavior seems to be independent of the organizational structure. If the market structure is derived from an ultimatum game or a Stackelberg game, neither individuals nor teams or groups maximize profits. However, depending on the organizational structure, teams or groups come closer to profit-maximizing behavior than individuals. An IO framing may direct individual behavior towards profit maximization, too. Therefore, an analysis of the effect of an IO framing or the implementation of an organizational structure requires a decision for a market structure first.

I conduct a Stackelberg experiment using Huck et al.'s (2001) market structure, which is also used by Müller and Tan (2011), in order to answer the question whether framing individual decision making as firm decision making or implement-

[7] Bornstein (2008) and Engel (2010) characterize, review and discuss experiments on group decision making, and they also survey some experiments on team decision making.

ing an organizational structure is more effective for generating profit-maximizing behavior. Firms are either represented by individuals or by two-member teams. Individuals are either neutrally instructed, or they are called "firms". Teams are organized according to a parsimonious version of Alchian and Demsetz's (1972) contractual model of the firm. Teams each consist of a decision maker and a non-decision maker. The non-decision maker is completely passive. The decision maker is active and gets half of the team's monetary payoff. The non-decision maker receives the other half. This experimental approach is of special interest for two reasons: First, it allows to control for the effect of an IO framing. Second, a test of the Stackelberg game as a theory of organizational behavior is feasible without the auxiliary hypothesis that single-person and multi-person firms show the same behavior.[8] If teams are found to behave more in line with the assumption of profit maximization than individuals, the mere presence of another person can be blamed for it. Such an observation would provide further evidence against the auxiliary hypothesis that single-person and multi-person firms show the same behavior, and it would support the hypothesis that large firms might come closer to profit-maximizing behavior than small firms. Of course, not much can be said about firms with complex organizational structures. However, much can be learned about oligopoly theory. Even if an oligopoly model like the Stackelberg game must be considered as falsified as a theory of all kinds of firms, it does not follow that it must be considered as falsified as a theory of a special kind of firm: It turns out that even my simple organizational structure increases its predictive validity. In particular, I find teams' quantity choices are more in line with the assumption of profit maximization than individuals' choices. Compared to individuals, teams appear to be less inequality averse.

The paper is organized as follows: Section 2 introduces the experimental design and the procedures. Section 3 presents the hypotheses and the experimental results, which are are summarized and discussed in Section 4. The appendix contains English translations of the instructions (originally written in German) and the payoff bimatrix used in all treatments.

2 Experimental design and procedures

2.1 Experimental design

The experimental market structure is derived from Huck et al.'s (2001) Stackelberg game. On a market for a homogeneous product, two firms compete in quantities. Firms A and B face a linear inverse demand function: $p(q) = \max\{30 - q, 0\}$,

[8] Albert and Hildenbrand (2012) show this auxiliary hypothesis is necessary if multi-person firms are represented by individuals in the laboratory.

$q = q_A + q_B$. Each cost function is linear in output: $c_j(q_j) = 6q_j$, $j = A, B$. Hence, marginal costs are constant and identical. Firms sequentially decide how much to supply to the market: Firm A moves first (leads), and firm B moves second (follows). Because B observes A's quantity choice, B's action is a reaction to A's decision. Once market supply is determined, the market clears. Firms' profits are equal to their revenues minus their production costs: $\pi_j(q_A, q_B) = [30 - (q_A + q_B)]q_j - 6q_j$, $j = A, B$.

In the experiment, each firm is either represented by an individual or by a two-member team. Overall, there are three treatments: NEUTRAL, LOADED, and TEAM (see Appendices A.1, A.2, and A.3 for English translations of the instructions). In NEUTRAL and LOADED, firms are each represented by an individual. In NEUTRAL, participants are neutrally instructed: Individuals choose "numbers" and receive "payments". NEUTRAL serves as a control treatment. In LOADED, participants are called "firms" competing in "quantities" for "profits" (firm framing).[9] In TEAM, participants are also neutrally instructed. Each team consists of a decision maker and a non-decision maker. The non-decision maker is completely passive. The decision maker is active and gets half of the team's monetary payoff. The non-decision maker receives the other half. An overview of the treatments is given in Table 1.

	Instructions	Sessions	Participants
NEUTRAL	neutral	2	$22 + 22 = 44$
LOADED	loaded	1	28
TEAM	neutral	1	48

Table 1: Treatments

In all treatments, each active participant plays ten (one-shot) Stackelberg games. In each game, the active participant in the leader role chooses a number from a (13×13) payoff bimatrix (see Appendix A.4),[10] and the active participant in the follower role is informed about the leader's choice. Being aware of the leader's decision, the follower chooses his number from the same payoff bimatrix, and the leader is informed about the follower's choice. Depending on the resulting combination of choices, both individuals, or both teams, receive monetary payoffs. In the following, I always speak of "choosing a quantity" and "receiving a profit" in order to keep the text as simple as possible.

In the payoff bimatrix, all possible combinations of quantity choices and the corresponding profits were shown. Each active participant could choose a quantity from the set $\{3, 4, \ldots, 15\}$. The profits were quoted in experimental currency

[9] It is identical to Huck et al.'s STACKRAND treatment.

[10] The same payoff bimatrix was not only applied by Huck et al. (2001) and Müller and Tan (2011). It was also used by Huck et al. (2002) and Fonseca et al. (2006).

units (ECU). In order to make monetary incentives for active participants in TEAM identical to those of participants in LOADED or NEUTRAL, the worth of 1 ECU in TEAM was twice as high as in the other treatments. In NEUTRAL and LOADED, 20 ECU were worth 1 EUR. In TEAM, 10 ECU were worth 1 EUR. The payoff bimatrix was derived from the Stackelberg game described above. In order to ensure the uniqueness of the Stackelberg equilibrium, 14 of the 169 profit pairs were slightly manipulated by subtracting 1 ECU.

2.2 Procedures

The experiment was conducted at Justus Liebig University Giessen in May and June 2011. Overall, 120 students from various fields of study, mostly from business administration, economics, and law, participated in four sessions. Participants were randomly recruited from a pool of potential participants. Each participant took part in only one session. Sessions consisted of ten rounds and lasted between 80 and 95 minutes (including the time to read the instructions). At the end of each session, two out of the ten rounds were randomly chosen to be rewarded. Participants' average earnings were 14.72 EUR (including a fixed amount of 9.00 EUR).[11] Rewards were paid out in private.

The experiment was run in lecture halls with pen and paper. At the beginning of each NEUTRAL or the LOADED session, participants were randomly assigned to be either a leader or a follower. This assignment remained fixed throughout the entire session. At the beginning of the TEAM session, participants were randomly assigned to be either a member of a team in the leader role (active or passive) or a member of a team in the follower role (active or passive). This assignment and the composition of the teams remained fixed throughout the entire session, too. Leaders and followers were seated in separate lecture halls. In order to prevent communication among participants located in the same lecture hall, they were seated with sufficient space between them. After having read the instructions, participants were allowed to ask questions in private. In each round, leaders and followers were randomly matched.[12] Hence, each active participant played ten (one-shot) Stackelberg games. At the end of all sessions, participants were asked to answer a questionnaire about their choices and the comprehensibility of the instructions.

Before the first round was started, participants were asked to answer a control question in order to make sure that all participants fully understood the payoff bimatrix. The answers were checked immediately (one follower in LOADED and one leader in TEAM answered the question incorrectly), and the question

[11] Without the flat amount, participants could have made losses in the experiment.

[12] In order to obtain a perfect stranger matching, Kamecke's (1997) rotation random-matching protocol was applied in all treatments.

was additionally answered in public. Nevertheless, in the questionnaire or when the rewards were paid out, three participants (one leader in NEUTRAL and two followers in LOADED) reported they had had problems with the payoff bimatrix. The data from these three participants are excluded from the analyses in the following section.

In all treatments, leaders and followers were labeled A and B. In TEAM, decision makers and non-decision makers were additionally labeled D and N.[13] In NEUTRAL and LOADED, the leaders received a sheet of writing paper on which they noted their identifiers and their quantity choices at the beginning of each round. The sheets were then passed on to the followers. The followers also noted their quantity choices, and the sheets were passed back to the leaders. At the end of a round, each participant knew (i) his choice, (ii) the other participant's choice, (iii) his profit, and (iv) the other participant's profit and wrote down information (i) to (iv) on a sheet of reporting paper. With that, a round was finished (see also Huck et al., 2001, p. 753). In TEAM, each decision maker additionally reported his choice and the other team's choice to his team member after each round. A team's profit was equally shared between its two team members.

3 Hypotheses and experimental results

In IO, firms are typically assumed to maximize their profits under rational expectations. In other words, it is assumed that firms behave according to a subgame-perfect Nash equilibrium prediction in the Stackelberg game: B maximizes its profit given A's quantity choice, and A correctly anticipates B's reaction to all possible quantity choices and maximizes its profit in the light of these anticipations. The subgame-perfect Nash equilibrium quantities $q_A^S = 12$ and $q_B^S = 6$ are given by $q_B(q_A^S) = 12 - \frac{q_A^S}{2}$ with $q_B(q_A) = \arg\max_{q_B} \pi_B(q_A, q_B)$ (best-response function) and $q_A^S = \arg\max_{q_A} \pi_A(q_A, q_B(q_A))$. This quantity combination is called Stackelberg outcome.

If A and B do not maximize their profits in the Stackelberg game, other outcomes can result from other kinds of preference-maximizing behavior. Because of the experimental results mentioned in the introduction, other-regarding preferences seem to be important. In the Stackelberg game, two well-known outcomes can be derived from other-regarding preferences under rational expectations: First, if A prefers equality to inequality (fairness) and B maximizes its own profit (selfishness), the Cournot outcome ensues: $q_A^C = 8$ and $q_B^C = 8$. Second, the joint profit is maximized if q_A and q_B add up to a total quantity of 12 (collusion). The symmetric joint profit-maximizing quantities are $q_A^J = 6$ and $q_B^J = 6$ (collusive outcome). The

[13] Actually, they were labeled E and N, because "Entscheider" is German for "decision maker".

collusive outcome results if B is fair and A is either selfish or fair and interested in profit. An overview of the predicted outcomes and associated profits is provided in Table 2.

	Stackelberg	Cournot	Collusion
Quantities	$q_A^S = 12,\ q_B^S = 6$	$q_A^C = q_B^C = 8$	$q_A^J = q_B^J = 6$
Total quantity	$q^S = 18$	$q^C = 16$	$q^J = 12$
Profits	$\pi_A^S = 72,\ \pi_B^S = 36$	$\pi_A^C = \pi_B^C = 64$	$\pi_A^J = \pi_B^J = 72$
Total profit	$\pi^S = 108$	$\pi^C = 128$	$\pi^J = 144$

Table 2: Predicted outcomes and associated profits

An overview of the mean quantities and the mean profits for all treatments is provided in Table 3; standard deviations are given in parentheses. The Stackelberg prediction fails for individuals and teams: Mean leader quantities are clearly lower and mean follower quantities are clearly higher than the Stackelberg quantities. There seems to be not much difference between NEUTRAL or LOADED and TEAM.[14]

	NEUTRAL	LOADED	TEAM
Quantities A, B	9.22, 7.69	9.79, 7.48	9.82, 7.59
	(2.21, 1.60)	(2.06, 1.47)	(2.16, 1.36)
Total quantity	16.91	17.27	17.41
	(2.27)	(2.10)	(1.86)
Profits A, B	61.64, 53.14	62.61, 49.18	61.60, 49.73
	(14.76, 18.65)	(15.75, 17.26)	(13.46, 17.11)
Total profit	114.78	111.79	111.33
	(27.89)	(26.36)	(24.42)

Table 3: Mean quantities and mean profits

Analyzing followers' choices in more detail reveals some differences. Because followers' actions are responses to leaders' choices, follower quantities cannot be directly compared: If followers use the same strategy in two treatments while leaders behave differently, different follower quantities will be observed. Therefore, the absolute value of the difference between the actual response of a follower, q_B, and the best response, $q_B(q_A)$, is considered (see also Subsection 2.1). This deviation is called a follower's "adjusted quantity", formally, $q_B^a = |q_B - q_B(q_A)|$. Thus, $q_B^a = 0$ if B behaves as a profit maximizer. Percentage frequencies of the adjusted follower quantities and mean values are reported in Table 4 for all treatments; standard deviations are given in parentheses. The TEAM treatment is

[14] Participants' actions in LOADED are similar with participants' actions in Huck et al.'s STACKRAND treatment. For a detailed comparison, see Hildenbrand (2012, pp. 9–11).

striking: More than 75 percent of the followers' responses are best responses. In all other treatments, best responses are less frequent and mean adjusted quantities are higher.

	0	1	2	3	4	5	6	7	8	9	Mean value
NEUTRAL	64.29	15.71	10.48	5.24	1.43	0.95	0.48	0.48	0.48	0.48	0.77 (1.42)
LOADED	59.17	20.00	10.83	5.83	3.33	0.00	0.00	0.00	0.83	0.00	0.79 (1.27)
TEAM	76.67	12.50	3.33	1.67	3.33	2.50	0.00	0.00	0.00	0.00	0.50 (1.15)

Table 4: Percentage frequencies of adjusted follower quantities and mean values

For all treatments, percentage frequencies of Stackelberg, Cournot, and collusive outcomes are shown in Table 5. The Cournot outcome is most frequently observed in each treatment. The Stackelberg outcome is clearly more frequent in TEAM than in the other treatments. Stackelberg outcomes occur with nearly the same frequency in NEUTRAL and LOADED. The same is true for Cournot outcomes. The TEAM treatment is striking again. Because the mere presence of another person can be blamed for it, the importance of other-regarding preferences becomes clear.

	Stackelberg $q_A^S = 12,\ q_B^S = 6$	Cournot $q_A^C = q_B^C = 8$	Collusion $q_A^J = q_B^J = 6$
NEUTRAL	8.57	27.62	1.90
LOADED	10.83	19.79	1.67
TEAM	16.67	17.50	0.00

Table 5: Percentage frequencies of Stackelberg, Cournot, and collusive outcomes

3.1 A firm framing directs individual behavior towards profit maximization

On the basis of an ultimatum game, Hoffman et al. (1994) analyze the effect of an IO framing. In the treatment group, participants are called "seller" and "buyer", and the proposer in the seller role "chooses the selling PRICE". In the control group, participants are neutrally instructed, and the proposer makes a "proposal". Hoffman et al. find proposers in the treatment group offer less than proposers in the control group. Responders' rejection rates do not differ significantly. Thus, proposers' actions are more in line with the assumption of profit maximization. Bühren et al. (2012) attribute the behavioral difference triggered by such a framing to the competitive environment created by it. From a mini-ultimatum experiment (see also Falk et al., 2003), they conclude "egoistic behavior is more acceptable" in a competitive environment than in a cooperative environment.

Compared to the NEUTRAL treatment, participants face a more competitive environment in LOADED. Because participants belong to the cultural environment of Europe, they can be assumed to be familiar with the idea that firms compete for profits. The firm framing is, therefore, expected to make egoistic behavior more acceptable. These considerations lead to

Hypothesis 1. Framing individual decision making as firm decision making will direct individual behavior towards profit maximization: (a) Leaders in LOADED will choose higher quantities than leaders in NEUTRAL. (b) Compared to followers' responses in NEUTRAL, followers' responses in LOADED will be closer to their best responses.

Mean follower quantities in LOADED are lower than in NEUTRAL, although mean leader quantities are higher in LOADED (see Table 3). Furthermore, best responses are more frequent in LOADED (see Table 4). Hence, the descriptive results point in the hypothesized direction. Nevertheless, follower behavior looks very similar, and followers' mean adjusted quantities in LOADED do not significantly differ from those in NEUTRAL (two-sided MWU test: $p = 0.549$): Followers are not found to be affected by the firm framing. Hence, Hypothesis 1 (b) is not supported.

Leaders' mean quantities in LOADED are not significantly different from those in NEUTRAL ($p = 0.157$) if a two-sided MWU test is applied. Using a one-sided MWU test, the difference is significant ($p = 0.078$): Leaders' mean quantities in LOADED are higher than in NEUTRAL. Therefore, Hypothesis 1 (a) is supported. This is interesting for two reasons. If leaders' motivations were identical in both treatments, leaders' actions could be explained by varying expectations. If, in addition, followers' motivations were identical in both treatments, leaders' expectations would mistakenly differ. Alternatively, leaders' actions could be explained by varying motivations: Choosing a higher quantity could be interpreted as being more egoistic. Because it cannot be excluded that the difference is only due to differences in expectations about follower behavior, it cannot be concluded that the firm framing makes leaders more egoistic.

3.2 An organizational structure is more effective for generating profit-maximizing behavior

In TEAM, a simple organizational structure is brought into the laboratory using a parsimonious version of Alchian and Demsetz's (1972) contractual model of the firm. For Alchian and Demsetz (p. 783), a firm is a contractual structure "with (a) joint input production, (b) several input owners, (c) one party who is common to all the contracts of the joint inputs, (d) who has rights to renegotiate any input's contract independently of contracts with other input owners, (e) who

holds the residual claim, and (f) who has the right to sell his central contractual residual status." Moreover, (g) individuals within the firm maximize (expected) utilities on the basis of utility functions increasing in income and leisure, and (h) the firm is organized in a way that individual utility maximization within the firm is transformed into profit maximization on the market.

Item (g) can be interpreted as a restricted version of the *homo oeconomics* model: While it is known from many experiments that individuals are not rational, egoistic, and materialistic, the hypothesis here is that they will behave in that way in a specific context. Specifically, if leisure is maintained, firm members maximize their income. In TEAM, requirements (a) to (f), and (h) are implicitly met, and the duration of the experiment is independent of the actions taken by the firm members. The non-decision maker can be interpreted as an owner, that is, the residual claimant. The decision maker can be seen as a manager, who is motivated by an incentive-compatible contract granting him half of the firm's profit.[15] Hence, teams are expected to maximize their profits because decision makers are predicted to maximize their incomes.

One explanation for a behavioral difference between an individual (on his own) and a decision maker (in a team) can be that the contract itself makes active participants more egoistic. Another explanation relies on other-regarding preferences: In contrast to an individual, a decision maker is not only (indirectly) responsible for his market partner's profit. He *is also* (directly) responsible for his team member's income. If individuals and decision makers have other-regarding preferences, teams come closer to profit-maximizing behavior than individuals if decision makers *also feel* responsible for their team members' incomes. Compared to framing individual decision making as firm decision making, an organizational structure is, therefore, expected to be more effective for generating profit-maximizing behavior. These thoughts lead to

Hypothesis 2. (a) Leaders in TEAM will choose higher quantities than leaders in (a1) NEUTRAL or (a2) LOADED. Compared to followers' responses in (a3) NEUTRAL or (a4) LOADED, followers' responses in TEAM will be closer to their best responses. (b) Followers' response functions in TEAM will be closer to the best-response function than those in (b1) NEUTRAL or (b2) LOADED.

Leaders' mean quantities in TEAM are higher than in NEUTRAL and LOADED (see Table 3). However, using two-sided MW*U* tests, neither leaders' mean quantities in LOADED nor leaders' mean quantities in NEUTRAL

[15] For a detailed discussion of this experimental approach, see Albert and Hildenbrand (2012, pp. 19–22). If it were rejected that teams were organized according to a parsimonious version of Alchian and Demsetz's (1972) contractual model of the firm, teams could be viewed as multi-person firms organized according to an ad-hoc theory of the firm, and the argumentation would still be valid.

significantly differ from those in TEAM ($p = 0.918$ and $p = 0.203$). Using a one-sided MWU test, the difference between TEAM and NEUTRAL is significant ($p = 0.101$): Leaders' mean quantities in TEAM are higher than in NEUTRAL. Hence, Hypothesis 2 (a1) is supported, and Hypothesis 2 (a2) is not supported.

Mean follower quantities in TEAM are lower than in NEUTRAL, and best responses are more frequent in TEAM. Mean follower quantities in TEAM are higher than in LOADED, but best responses are also more frequent in TEAM (see Tables 3 and 4). Therefore, most descriptive results point in the hypothesized direction. Using two-sided MWU tests, neither followers' mean adjusted quantities in LOADED nor followers' mean adjusted quantities in NEUTRAL are significantly different from those in TEAM ($p = 0.191$ and $p = 0.573$). Using a one-sided MWU test, the difference between TEAM and LOADED is significant ($p = 0.096$): Followers' mean adjusted quantities in TEAM are lower than in LOADED. Thus, Hypothesis 2 (a3) is not supported, and Hypothesis 2 (a4) is supported.

On the one hand, the weak MWU test results are surprising because of the clear descriptive results, on the other hand, treating each active participant as one observation by using his mean quantity choice of all rounds is an extremely conservative method to overcome the problem of repeated measurement. A less extreme way to deal with this problem is to apply a dummy variable regression in order to test for treatment effects: If TEAM is the treatment group, NEUTRAL and LOADED can serve as control groups. Either leaders' quantities or followers' adjusted quantities are regressed on a constant and a binary variable ($team$), which is one for the observations belonging to the treatment group.

Formally, the model can be written as

$$\begin{aligned} quantity &= \beta_0 + \beta_1 team + \sum_{p=1}^{P} \gamma_p participant_p + \sum_{r=1}^{10} \delta_r round_r + u, \\ \sum_{p=1}^{P} \gamma_p &= 0, \\ \sum_{r=1}^{10} \delta_r &= 0, \end{aligned}$$

where $quantity$ is either leaders' quantities or followers' adjusted quantities in either NEUTRAL and TEAM or LOADED and TEAM. To control for both participant effects and round influences, a dummy variable for each participant ($participant_p$ for participants $p = 1, 2, \ldots, P$) and for each round ($round_r$ for rounds $r = 1, 2, \ldots, 10$) is included. The error term (u) contains unobserved factors affecting $quantity$.[16]

[16] Because each participant is observed in each round, the error terms might be correlated. Here, serial correlation is likely to result from an unobserved effect, namely, different (time-constant)

Following Suits (1984), the sum of the coefficients of each set of dummy variables is constrained to zero (see also Königstein, 2000). The intercept parameter β_0 can, therefore, be interpreted as the mean quantity in NEUTRAL or LOADED, respectively. The slope parameter β_1 is the difference in mean quantities between either NEUTRAL and TEAM or LOADED and TEAM. If β_1 is estimated to be significantly different from zero, a treatment effect is present. The estimates of β_0 and β_1, $\hat{\beta}_0$ and $\hat{\beta}_1$, are reported in Table 6; standard errors and p-values for the two-sided standard t tests are shown in parentheses. For q_A, the p-value for the two-sided t test $H_0 : \beta_0 = 12$ is also given.

		$\hat{\beta}_0$	$\hat{\beta}_1$
NEUTRAL	q_A	9.22	0.60
		$(0.13, p = 0.000; p_{12} = 0.000)$	$(0.21, p = 0.005)$
	q_B^a	0.76	−0.26
		$(0.07, p = 0.000)$	$(0.12, p = 0.032)$
LOADED	q_A	9.75	0.06
		$(0.16, p = 0.000; p_{12} = 0.000)$	$(0.22, p = 0.771)$
	q_B^a	0.79	−0.29
		$(0.10, p = 0.000)$	$(0.14, p = 0.038)$

Table 6: Treatment effects

Except for the difference in leaders' mean quantities between LOADED and TEAM ($p = 0.771$), treatment effects are significant and have the expected signs. Again, Hypothesis 2 (a1) is supported, and Hypothesis 2 (a2) is not supported: Leaders in TEAM behave more like profit maximizers than leaders in NEUTRAL, and leaders in LOADED behave in the same way as leaders in TEAM. In contrast to the results on followers' mean adjusted quantities obtained above, not only Hypothesis 2 (a4), but also Hypothesis 2 (a3) is supported. Followers in TEAM are found to be more egoistic than in NEUTRAL or LOADED. Thus, teams' quantity choices are more in line with the assumption of profit maximization than individuals' choices, or, to put it the other way round, the organizational structure is more effective for generating profit-maximizing behavior than the firm framing. Nevertheless, teams do not completely behave as profit maximizers.[17]

In order to find out whether the observed behavior can be explained by other-regarding preferences, followers' responses are analyzed in more detail by estimating their response functions, $q_B = \beta_0 + \beta_1 q_A$, for all treatments. If followers behaved as profit maximizers, the estimated response function would be $\widehat{q_B} = 12.09 - 0.49 q_A$ in each treatment. Again, a constrained dummy variable

preferences. Serial correlation can also result from learning. In order to avoid these two problems, it is controlled for participant effects and round influences.

[17] Participant effects and round influences are estimated to be present for a small number of participants and rounds.

regression is used, including intercept and slope dummy variables for participants and rounds. Because the sum of the coefficients of each set of dummy variables is restricted to zero, the intercept parameter β_0 and the slope parameter β_1 represent means. The estimates $\hat{\beta}_0$ and $\hat{\beta}_1$ of β_0 and β_1 are shown in Table 7; standard errors and p-values for the two-sided standard t tests are given in parentheses. In addition, p-values for the two-sided t tests $H_0 : \beta_0 = 12.09$ and $H_0 : \beta_1 = 0.49$ are also shown.

	$\hat{\beta}_0$	$\hat{\beta}_1$
NEUTRAL	9.61	−0.21
	$(0.40, p = 0.000; p_{12.09} = 0.000)$	$(0.04, p = 0.000; p_{0.49} = 0.000)$
LOADED	10.45	−0.30
	$(0.49, p = 0.000; p_{12.09} = 0.001)$	$(0.05, p = 0.000; p_{0.49} = 0.000)$
TEAM	10.84	−0.33
	$(0.48, p = 0.000; p_{12.09} = 0.012)$	$(0.05, p = 0.000; p_{0.49} = 0.000)$

Table 7: Estimated response functions

In TEAM, the estimated intercept is 10.84, and the estimated intercepts in LOADED and NEUTRAL are lower. In each treatment, the estimated slope of the response function is negative, and the absolute value of the estimated slope is largest in TEAM. Therefore, followers' response functions in TEAM appear to be closer to the best-response function than those in the other treatments, and Hypotheses 2 (b1, b2) are supported.

If followers' response functions looked like in Table 7, leaders' profit-maximizing quantities would be 9.11 in NEUTRAL, 9.68 in LOADED, and 9.82 in TEAM. These quantities are very close to leaders' mean quantities: 9.22 in NEUTRAL, 9.79 in LOADED, and 9.82 in TEAM (see Table 3). In TEAM, leaders' mean quantity even corresponds with the profit-maximizing quantity. Thus, here too, the organizational structure is found to be more effective for generating profit-maximizing behavior than the firm framing: Teams' quantity choices are more in line with the assumption of profit maximization than individuals' choices. However, intercept and slope of the estimated response function in each treatment differ from the parameters of the best-response function significantly, and leaders' mean quantities in NEUTRAL and LOADED are higher than the profit-maximizing quantities.

Given the estimated response function in TEAM, leaders maximize their profits on average. In NEUTRAL and LOADED, leaders' mean behavior is harder to interpret: An interpretation relies on leaders' expectations. If followers' estimated response functions were correct and expected, leaders' mean quantity choices, compared to the profit-maximizing choices, would lead to less profits for both interacting individuals and would increase inequality in profits. Leaders would be

inequality loving, and the loss of profit could be interpreted as their willingness to pay for the increase in (positive) inequality. This explanation is not convincing in view of Fehr and Schmidt's (1999) or Bolton and Ockenfels' (2000) experimental results on inequality aversion: Typically, participants are found to be inequality averse instead of inequality loving. Hence, it is more likely that leaders' expectations are wrong or followers' actual response functions are different in NEUTRAL and LOADED.

However, mean follower behavior is in line with Fehr and Schmidt's and Bolton and Ockenfels's findings. In NEUTRAL, LOADED, and TEAM, estimated response functions intersect the best-response function at $q_A = 8.63$, $q_A = 8.86$, and $q_A = 7.81$, implying that, from the leader quantity of 9 upwards in NEUTRAL and LOADED or 8 upwards in TEAM, followers choose more than the profit-maximizing quantity on average. By doing so, negative inequality decreases. From the leader quantity of 7 in TEAM or 8 in NEUTRAL and LOADED, followers choose less than predicted. This mean behavior also decreases inequality, namely, positive inequality. Because of the steepest slope of the response function in TEAM, inequality aversion is weaker in TEAM than in NEUTRAL or LOADED.

On the whole, it can be said that teams are found to be less inequality averse than individuals. If individual decision making is framed as firm decision making, individual behavior is also directed towards profit maximization, but the implementation of an organizational structure is more effective. Because even a simple organizational structure increases the predictive validity of the Stackelberg game, it need not be considered as falsified as a theory of organizational behavior.

4 Conclusion

In this paper, a Stackelberg experiment is considered in order to answer the question whether framing individual decision making as firm decision making or implementing an organizational structure is more effective for generating the behavior which is mostly assumed in IO, namely, profit-maximizing. The experimental market structure is derived from Huck et al.'s (2001) Stackelberg game of duopolistic quantity competition with homogeneous products. Overall, there are three treatments: NEUTRAL, LOADED, and TEAM. In NEUTRAL and LOADED, firms are each represented by an individual. In NEUTRAL, participants are neutrally instructed: Individuals choose "numbers" and receive "payments". In LOADED, participants are called "firms" competing in "quantities" for "profits". Individuals in NEUTRAL and LOADED can be seen as single-person firms. In TEAM, participants are also neutrally instructed. Teams each consist of a decision maker and a non-decision maker. The non-decision maker is completely passive. The decision maker is active and gets half of the team's monetary payoff. The non-decision

maker receives the other half. Teams can be viewed as multi-person firms organized according to a parsimonious version of Alchian and Demsetz's (1972) contractual model of the firm.

I find neither individuals nor teams are strict profit maximizers in the Stackelberg game. However, if individual decision making is framed as firm decision making, leaders behave more like profit maximizers: Leaders in LOADED choose higher quantities than leaders in NEUTRAL. Followers motivations are not affected by the firm framing: Followers in LOADED behave in the same way as followers in NEUTRAL. Teams are found to come closer to profit maximization: Leaders in TEAM behave in the same way as leaders in LOADED, but followers in TEAM behave more like profit maximizers than followers in LOADED. Therefore, the organizational structure is most effective for generating profit-maximizing behavior. Teams are found to be less inequality averse than individuals. Followers' response functions in TEAM appear to be closer to the best-response function than those in the other treatments. Given the estimated response function, leaders' mean quantity in TEAM is a profit-maximizing choice.

What can be learned about firms with complex organizational structures? Of course, not much! However, much can be learned about IO. Because even a simple organizational structure increases the predictive validity of the Stackelberg game, it need not be considered as falsified as a theory of organizational behavior. Larger firms with more complex organizational structures might come even closer to profit-maximizing behavior. In the experiment, multi-person firms behave more like profit maximizers than single-person firms. This is surprising in view of the simplicity of the organizational structure. Each firm only consists of a passive and an active firm member. There is no communication between them, and there is no such thing as a team spirit: The TEAM treatment is done without loaded instructions or team-building activities.

Whether the behavioral difference between single-person and multi-person firms is triggered by other-regarding preferences between firm members or whether the contract of employment makes people more selfish is still an open question. In order to answer it, other employment contracts could be implemented, or firm sizes could be increased. Because firms are typically assumed to be large in oligopoly theory, increasing firm sizes might be the preferred choice. However, because of the rising costs in the laboratory and the great significance of team production problems in the field, a variation of the organizational structure and an implementation of more complex employment contracts might be a promising approach.

Another approach could be the implementation of an IO framing in addition to an organizational structure. However, this would be challenging, because it would not be clear how such a framing should look like. If, for example, active participants were called "managers" and passive participants were called "owners",

the environment created by this framing might be more or less competitive than an environment with "agents" and "principals" or "subordinates" and "superiors". For such an approach to be successful, a more general theory of framing would be needed first. A lot of research could be done here, too.

Acknowledgements: For detailed comments, I am grateful to Max Albert, Matthias Greiff, Michael Hesch, Björn Kuchinke, David Reinstein (referee), Katharine Rockett (editor), Filip Vesely, two anonymous readers, and an anonymous referee. I thank participants at the 2011/12 Tübingen Economic Workshop, the 2012 Hohenheimer Oberseminar, and the 2012 ESA European Conference for useful suggestions. I also thank Steffen Huck, Wieland Müller, and Hans-Theo Normann for providing their data.

A Appendix

A.1 Translated instructions: LOADED

Welcome to our experiment!

Please read the instructions carefully. Do not talk to your neighbors during the entire experiment. Raise your hand if you have questions. We will come around and answer your questions.

Your participation in the experiment will be rewarded. Depending on your behavior and the behavior of other participants you are matched with, you receive lower or higher monetary rewards in EUR.

You represent a firm selling the same product as another firm on a market. Both firms each make one decision. That is, each firm chooses the quantity it wants to sell on the market. The resulting combination of quantities is associated with a profit for each firm.

The profits associated with each combination of quantities are shown in the attached table.

The quantities which can be chosen by firm A are displayed in the head of each row. The quantities which can be chosen by firm B are displayed in the head of each column. The profits associated with a combination of quantities are shown in the corresponding cell. The entry on the left side of the vertical bar corresponds to firm A's profit. The entry on the right side of the vertical bar corresponds to firm B's profit.

The profits are quoted in ECU (experimental currency unit). The exchange rate between ECU and EUR is 1/20. That is, 20 ECU are exchanged for 1 EUR.

How are the decisions made?

Please take a look at your identifier. If it begins with an A, you represent a firm A. If it begins with a B, you represent a firm B.

Firm A is the first to make a decision. That is, firm A chooses its quantity (picks a row), and firm B will be informed about firm A's choice. Being aware of firm A's decision, firm B chooses its quantity (picks a column), and firm A will be informed about firm B's choice. With that, a round is finished. That is, at the end of a round, each firm knows (i) its quantity, (ii) the other firm's quantity, (iii) its profit, and (iv) the other firm's profit.

Decisions are communicated in writing. Each firm A gets a sheet of writing paper at the beginning of each round.

Please write down information (i) to (iv) on the attached sheet of reporting paper.

In total, there are ten rounds. You do not know the participant you interact with. In each round, you will be matched with a different participant.

Anonymity among participants and towards experimenters is preserved. Your decisions can only be traced back to your identifier. Your personal data will not be associated with your identifier.

At the end of the experiment, two out of the ten rounds will be randomly chosen to be rewarded. The sum of your profits from these two rounds determines the variable part of your monetary reward in EUR. It can be positive, zero, or negative. In addition, you will receive a fixed amount of 9 EUR. Your monetary reward will be paid out in private. That is, the other participants will not learn about the amount of your monetary reward.

A.2 Translated instructions: NEUTRAL

Welcome to our experiment!

Please read the instructions carefully. Do not talk to your neighbors during the entire experiment. Raise your hand if you have questions. We will come around and answer your questions.

Your participation in the experiment will be rewarded. Depending on your behavior and the behavior of other participants you are matched with, you receive lower or higher monetary rewards in EUR.

You interact with another participant. Both participants each make one decision. That is, each participant chooses the number he wants to use. The resulting combination of numbers is associated with a payment for each participant.

The payments associated with each combination of numbers are shown in the attached table.

The numbers which can be chosen by participant A are displayed in the head of each row. The numbers which can be chosen by participant B are displayed in the head of each column. The payments associated with a combination of numbers are shown in the corresponding cell. The entry on the left side of the vertical bar

corresponds to participant A's payment. The entry on the right side of the vertical bar corresponds to participant B's payment.

The payments are quoted in ECU (experimental currency unit). The exchange rate between ECU and EUR is 1/20. That is, 20 ECU are exchanged for 1 EUR.

How are the decisions made?

Please take a look at your identifier. If it begins with an A, you are a participant A. If it begins with a B, you are a participant B.

Participant A is the first to make a decision. That is, participant A chooses his number (picks a row), and participant B will be informed about participant A's choice. Being aware of participant A's decision, participant B chooses his number (picks a column), and participant A will be informed about participant B's choice. With that, a round is finished. That is, at the end of a round, each participant knows (i) his number, (ii) the other participant's number, (iii) his payment, and (iv) the other participant's payment.

Decisions are communicated in writing. Each participant A gets a sheet of writing paper at the beginning of each round.

Please write down information (i) to (iv) on the attached sheet of reporting paper.

In total, there are ten rounds. You do not know the participant you interact with. In each round, you will be matched with a different participant.

Anonymity among participants and towards experimenters is preserved. Your decisions can only be traced back to your identifier. Your personal data will not be associated with your identifier.

At the end of the experiment, two out of the ten rounds will be randomly chosen to be rewarded. The sum of your payments from these two rounds determines the variable part of your monetary reward in EUR. It can be positive, zero, or negative. In addition, you will receive a fixed amount of 9 EUR. Your monetary reward will be paid out in private. That is, the other participants will not learn about the amount of your monetary reward.

A.3 Translated instructions: TEAM

Welcome to our experiment!

Please read the instructions carefully. Do not talk to your neighbors during the entire experiment. Raise your hand if you have questions. We will come around and answer your questions.

Your participation in the experiment will be rewarded. Depending on your behavior and the behavior of other participants you are matched with, you receive lower or higher monetary rewards in EUR.

You and another participant (partner) are a team. As a team, you interact with another team. Both teams each make one decision. That is, each team chooses the

number it wants to use. The resulting combination of numbers is associated with a payment for each team.

The payments associated with each combination of numbers are shown in the attached table.

The numbers which can be chosen by team A are displayed in the head of each row. The numbers which can be chosen by team B are displayed in the head of each column. The payments associated with a combination of numbers are shown in the corresponding cell. The entry on the left side of the vertical bar corresponds to team A´s payment. The entry on the right side of the vertical bar corresponds to team B´s payment.

The payments are quoted in ECU (experimental currency unit). The exchange rate between ECU and EUR is 1/10. That is, 10 ECU are exchanged for 1 EUR.

How are the decisions made?

Please take a look at your identifier. If it begins with an A, you are a member of a team A. If it begins with a B, you are a member of a team B. Each team consists of a decision maker and a non-decision maker. If your identifier contains a D, you are a decision maker. If your identifier contains an N, you are a non-decision maker.

Decision maker A is the first to make a decision. That is, decision maker A chooses his number (picks a row), and decision maker B will be informed about decision maker A´s choice. Being aware of decision maker A´s decision, decision maker B chooses his number (picks a column), and decision maker A will be informed about decision maker B´s choice. Finally, non-decision maker A and non-decision maker B will be informed about the choices. With that, a round is finished. That is, at the end of a round, each team knows (i) its number, (ii) the other team's number, (iii) its payment, (iv) and the other team's payment.

Decisions are communicated in writing. Each decision maker A gets a sheet of writing paper at the beginning of each round. All decision makers have reporting sheets.

Please write down information (i) to (iv) on the attached sheet of reporting paper. If you are a non-decision maker, please also note whether you are satisfied with your partner's decision and what your decision would have been.

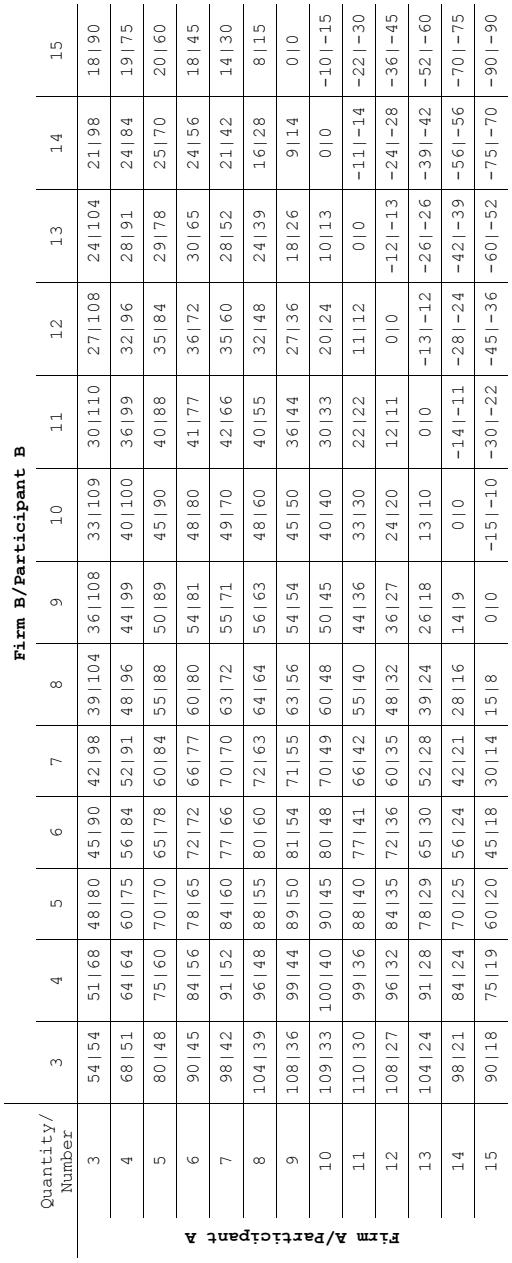
In total, there are ten rounds. You do not know the team you interact with. In each round, you will be matched with a different team. The composition of the teams does not change during the entire experiment.

Anonymity among participants and towards experimenters is preserved. Your decisions can only be traced back to your identifier. Your personal data will not be associated with your identifier.

At the end of the experiment, two out of the ten rounds will be randomly chosen to be rewarded. The sum of your payments from these two rounds determines the variable part of your team's monetary reward in EUR, which will be equally shared

between you and your partner. It can be positive, zero, or negative. In addition, you will receive a fixed amount of 9 EUR. Your monetary reward will be paid out in private. That is, the other participants will not learn about the amount of your monetary reward.

A.4 Payoff bimatrix: LOADED/NEUTRAL and TEAM



Firm A/Participant A: Quantity/Number	Firm B/Participant B: 3	4	5	6	7	8	9	10	11	12	13	14	15
3	54|54	51|68	48|80	45|90	42|98	39|104	36|108	33|109	30|110	27|108	24|104	21|98	18|90
4	68|51	64|64	60|75	56|84	52|91	48|96	44|99	40|100	36|99	32|96	28|91	24|84	19|75
5	80|48	75|60	70|70	65|78	60|84	55|88	50|89	45|90	40|88	35|84	29|78	25|70	20|60
6	90|45	84|56	78|65	72|72	66|77	60|80	54|81	48|80	41|77	36|72	30|65	24|56	18|45
7	98|42	91|52	84|60	77|66	70|70	63|72	55|71	49|70	42|66	35|60	28|52	21|42	14|30
8	104|39	96|48	88|55	80|60	72|63	64|64	56|63	48|60	40|55	32|48	24|39	16|28	8|15
9	108|36	99|44	89|50	81|54	71|55	63|56	54|54	45|50	36|44	27|36	18|26	9|14	0|0
10	109|33	100|40	90|45	80|48	70|49	60|48	50|45	40|40	30|33	20|24	10|13	0|0	-10|-15
11	110|30	99|36	88|40	77|41	66|42	55|40	44|36	33|30	22|22	11|12	0|0	-11|-14	-22|-30
12	108|27	96|32	84|35	72|36	60|35	48|32	36|27	24|20	12|11	0|0	-12|-13	-24|-28	-36|-45
13	104|24	91|28	78|29	65|30	52|28	39|24	26|18	13|10	0|0	-13|-12	-26|-26	-39|-42	-52|-60
14	98|21	84|24	70|25	56|24	42|21	28|16	14|9	0|0	-14|-11	-28|-24	-42|-39	-56|-56	-70|-75
15	90|18	75|19	60|20	45|18	30|14	15|8	0|0	-15|-10	-30|-22	-45|-36	-60|-52	-75|-70	-90|-90

References

Albert, M., and Hildenbrand, A. (2012). Industrial Organization in the Laboratory. MAGKS Joint Discussion Paper 05-2012, Department of Business Administration and Economics, Philipps University Marburg. URL http://ideas.repec.org/p/mar/magkse/201205.html.

Alchian, A., and Demsetz, H. (1972). Production, Information Costs, and Economic Organization. *American Economic Review*, 62: 777–795. URL http://ideas.repec.org/a/aea/aecrev/v62y1972i5p777-95.html.

Bühren, C., Frank, B., Krabel, S., and Werner, A. (2012). Decision-Making in Competitive Framings: Strategic Behavior of Chess Players in Mini-Ultimatum Game Chess Puzzles. *Economics Letters*, 115: 356–358. URL http://ideas.repec.org/a/eee/ecolet/v115y2012i3p356-358.html.

Bolton, G., and Ockenfels, A. (2000). ERC: A Theory of Equity, Reciprocity, and Competition. *American Economic Review*, 90: 166–193. URL http://www.jstor.org/stable/117286.

Bornstein, G. (2008). A Classification of Games by Player Type. In A. Biel, D. Eek, T. Gärling, and M. Gustafsson (Eds.), *New Issues and Paradigms in Research on Social Dilemmas*, chapter 3, pages 27–42. New York: Springer. URL http://link.springer.com/chapter/10.1007%2F978-0-387-72596-3_3.

Bornstein, G., and Gneezy, U. (2002). Price Competition between Teams. *Experimental Economics*, 5: 29–38. URL http://ideas.repec.org/a/kap/expeco/v5y2002i1p29-38.html.

Bornstein, G., Kugler, T., Budescu, D., and Selten, R. (2008). Repeated Price Competition Between Individuals and Between Teams. *Journal of Economic Behavior & Organization*, 66: 808–821. URL http://ratiolab.huji.ac.il/gary/article14.pdf.

Bornstein, G., and Yaniv, I. (1998). Individual and Group Behavior in the Ultimatum Game: Are Groups More "Rational" Players? *Experimental Economics*, 1: 101–108. URL http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.138.4053.

Engel, C. (2010). The Behaviour of Corporate Actors: How Much Can We Learn From the Experimental Literature? *Journal of Institutional Economics*, 6: 445–475. URL http://ideas.repec.org/a/cup/jinsec/v6y2010i04p445-475_00.html.

Falk, A., Fehr, E., and Fischbacher, U. (2003). On the Nature of Fair Behavior. *Economic Inquiry*, 41: 20–26. URL http://ideas.repec.org/a/oup/ecinqu/v41y2003i1p20-26.html.

Fehr, E., and Schmidt, K. (1999). A Theory of Fairness, Competition, and Cooperation. *Quarterly Journal of Economics*, 114: 817–868. URL http://ideas.repec.org/a/tpr/qjecon/v114y1999i3p817-868.html.

Fonseca, M., Huck, S., and Normann, H.-T. (2005). Playing Cournot Although They Shouldn't: Endogenous Timing in Experimental Duopolies with Asymmetric Cost. *Economic Theory*, 25: 669–677. URL http://www.jstor.org/stable/25055904.

Fonseca, M., Müller, W., and Normann, H.-T. (2006). Endogenous Timing in Duopoly: Experimental Evidence. *International Journal of Game Theory*, 34: 443–456. URL http://ideas.repec.org/a/spr/jogath/v34y2006i3p443-456.html.

Furubotn, E., and Richter, R. (2005). *Institutions and Economic Theory: The Contribution of the New Institutional Economics*. Ann Arbor: University of Michigan Press, 2 edition.

Hildenbrand, A. (2010). Cournot or Stackelberg Competition? A Survey of Experimental Research. MPRA Paper 26845, Munich Personal RePEc Archive, Ludwig-Maximilians University Munich. URL http://ideas.repec.org/p/pra/mprapa/24468.html.

Hildenbrand, A. (2012). Is a "Firm" a Firm? A Stackelberg Experiment. Economics Discussion Paper 2012-53, Kiel Institute for the World Economy. URL http://www.economics-ejournal.org/economics/discussionpapers/2012-53.

Hoffman, E., McCabe, K., Shachat, K., and Smith, V. (1994). Preferences, Property Rights, and Anonymity in Bargaining Games. *Games and Economic Behavior*, 7: 346–380. URL http://ideas.repec.org/a/eee/gamebe/v7y1994i3p346-380.html.

Holmstrom, B., and Tirole, J. (1989). The Theory of the Firm. In R. Schmalensee, and R. D. Willig (Eds.), *Handbook of Industrial Organization*, volume 1, chapter 2, pages 61–133. North-Holland.

Holt, C. (1985). An Experimental Test of the Consistent-Conjectures Hypothesis. *American Economic Review*, 75: 314–325. URL http://ideas.repec.org/a/aea/aecrev/v75y1985i3p314-25.html.

Huck, S., Müller, W., and Normann, H. (2001). Stackelberg Beats Cournot: On Collusion and Efficiency in Experimental Markets. *Economic Journal*, 111: 749–765. URL http://www.jstor.org/stable/798411.

Huck, S., Müller, W., and Normann, H.-T. (2002). To Commit or Not to Commit: Endogenous Timing in Experimental Duopoly Markets. *Games and Economic Behavior*, 38: 240–264. URL http://ideas.repec.org/a/eee/gamebe/v38y2002i2p240-264.html.

Huck, S., Normann, H.-T., and Oechssler, J. (2004). Two Are Few and Four Are Many: Number Effects in Experimental Oligopolies. *Journal of Economic Behavior & Organization*, 53: 435–446. URL http://ideas.repec.org/a/eee/jeborg/v53y2004i4p435-446.html.

Huck, S., and Wallace, B. (2002). Reciprocal Strategies and Aspiration Levels in a Cournot-Stackelberg Experiment. *Economics Bulletin*, 3: 1–7. URL http://ideas.repec.org/a/ebl/ecbull/v3y2002i3p1-7.html.

Kamecke, U. (1997). Rotations: Matching Schemes that Efficiently Preserve the Best Reply Structure of a One Shot Game. *International Journal of Game Theory*, 26: 409–417. URL http://link.springer.com/article/10.1007/BF01263281?null.

Königstein, M. (2000). Measuring Treatment-Effects in Experimental Cross-Sectional Time Series. In M. Königstein (Ed.), *Equity, Efficiency and Evolutionary Stability in Bargaining Games with Joint Production*, chapter 2, pages 33–43. Berlin: Springer.

Lau, S.-H., and Leung, F. (2010). Estimating a Parsimonious Model of Inequality Aversion in Stackelberg Duopoly Experiments. *Oxford Bulletin of Economics and Statistics*, 72: 669–686. URL http://onlinelibrary.wiley.com/doi/10.1111/j.1468-0084.2010.00592.x/full.

Müller, W. (2006). Allowing for Two Production Periods in the Cournot Duopoly: Experimental Evidence. *Journal of Economic Behavior & Organization*, 60: 100–111. URL http://ideas.repec.org/a/eee/jeborg/v60y2006i1p100-111.html.

Müller, W., and Tan, F. (2011). Who Acts More Like a Game Theorist? Group and Individual Play in a Sequential Market Game and the Effect of the Time Horizon. Working Paper 1111, Department of Economics, University of Vienna. URL http://ideas.repec.org/p/vie/viennp/1111.html.

Nadiri, M. (1982). Producers Theory. In K. J. Arrow, and M. D. Intriligator (Eds.), *Handbook of Mathematical Economics*, volume 2, chapter 10, pages 431–490. Amsterdam: North-Holland. URL http://www.econ.nyu.edu/user/nadiri/pub37.PDF.

Normann, H.-T., and Ruffle, B. (2011). Introduction to the Special Issue on Experiments in Industrial Organization. *International Journal of Industrial*

Organization, 29: 1–3. URL http://econpapers.repec.org/article/eeeindorg/v_3a29_3ay_3a2011_3ai_3a1_3ap_3a1-3.htm.

Raab, P., and Schipper, B. (2009). Cournot Competition Between Teams: An Experimental Study. *Journal of Economic Behavior & Organization*, 72: 691–702. URL http://ideas.repec.org/a/eee/jeborg/v72y2009i2p691-702.html.

Sauermann, H., and Selten, R. (1959). Ein Oligopolexperiment. *Zeitschrift für die gesamte Staatswissenschaft*, 115: 427–471. URL http://www.jstor.org/discover/10.2307/40748152?uid=26293&uid=2943608&uid=3737864&uid=2134&uid=2&uid=70&uid=3&uid=2928688&uid=26292&uid=67&uid=62&uid=5910216&sid=21102252360517.

Scherer, F., and Ross, D. (1990). *Industrial Market Structure and Economic Performance*. Boston: Houghton Mifflin, 3 edition.

Selten, R. (1967a). Die Strategiemethode zur Erforschung des eingeschränkt rationalen Verhaltens im Rahmen eines Oligopolexperiments. In H. Sauermann (Ed.), *Beiträge zur experimentellen Wirtschaftsforschung*, chapter 5, pages 136–168. Tübingen: Mohr.

Selten, R. (1967b). Ein Oligopolexperiment mit Preisvariation und Investition. In H. Sauermann (Ed.), *Beiträge zur experimentellen Wirtschaftsforschung*, chapter 4, pages 103–135. Tübingen: Mohr.

Shapiro, C. (1989). Theories of Oligopoly Behavior. In R. Schmalensee, and R. D. Willig (Eds.), *Handbook of Industrial Organization*, volume 1, chapter 6, pages 329–414. North-Holland. URL http://ideas.repec.org/h/eee/indchp/1-06.html.

Suits, D. (1984). Dummy Variables: Mechanics V. Interpretation. *Review of Economics and Statistics*, 66: 177–180. URL http://ideas.repec.org/a/tpr/restat/v66y1984i1p177-80.html.

Tirole, J. (1988). *The Theory of Industrial Organization*. Cambridge: MIT Press.