Testing Forbearance Experimentally —Duopolistic Competition of Conglomerate Firms—*

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Like Feinberg and Sherman (1985) and Phillips and Mason (1992), we test experimentally whether conglomerate firms, i.e. firms competing on multiple, structurally unrelated markets, effectively limit competition. Unlike these authors, our more general analysis assumes differentiated rather than homogeneous products and distinguishes strategic substitutes as well as complements to test their forbearance hypothesis. We vary the duration of the interaction to disentangle effects of forbearance and repetition. Surprisingly, rather than limiting competition, conglomerate firms foster it. In line with our expectations, we find more cooperation with strategic complements than with strategic substitutes and also more cooperation with long term than with short term interaction.

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1. Introduction

Typically, large firms do not only offer many products, they also sell them in several distinct national and international markets. Although there are some early examples, for instance, Siemens, which had foreign subsidiaries as early as in the beginning of the last century, the rapid growth of firms going conglomerate is fairly recent. In contrast to modern large firms, the firms at the beginning of the last century were conglomerates operating in unrelated markets and confronted the same conglomerate rivals in these markets. These multimarket contacts by conglomerate firms made economists afraid that the former might lead to collusive behaviour. Corwin D. Edwards was among the first pointing to the potential of anti-competitive market outcomes:

> "There is an awareness that if competition against the large rival goes so far as to be seriously troublesome, the logic of the situation may call for conversion of the warfare into total war. Hence there is an incentive to live and let live, to cultivate a cooperative spirit, and to recognise priorities of interest in the hope of reciprocal recognition. Those attitudes support such policies as refraining from sale in a large company's home market below whatever price that company may have established there; refraining from entering into the production of a commodity which a large company has developed; not contesting the patent claims of a large company even when they are believed to be invalid; abstaining from an effort to win away the important customers of a large rival; and sometimes refusing to accept such customers even when they take the initiative." (Edwards, 1955, p. 335).

Although conglomerates seem less frequent in the age of globalisation, the concern that multimarket firms mutually refrain from competing even in related markets remains. Despite the potential for mutual forbearance among multiproduct firms, relatively few experiments have been done to analyse their competitive behaviour and market outcomes. Our attempt to test the mutual forbearance hypothesis is inspired by theoretical and experimental studies.

Theoretically, Bernheim and Whinston (1990) show that asymmetries among multimarket firms and among market structures facilitate mutual forbearance due to the threat of punishment. Markets with a less efficient punishment technology benefit from markets where punishment is more efficient in a conglomerate. Firms will cooperate in markets with less efficient punishment since they have to anticipate retaliation in the other market.

A first experimental study by Feinberg and Sherman (1985, 1988) assumes that two firms compete repeatedly in two markets with identical demand and cost conditions, zero cross-elasticity of linear demand across markets and linear production costs in both firms. Apart from this, the markets are unrelated. The results provide some support for the mutual forbearance hypothesis. Contrary to Bernheim and Whinston

(1990), Feinberg and Sherman (1985) found a forbearance effect even for identical markets.

Phillips and Mason (1992) study the repeated interaction of conglomerates where the two markets differ and support the idea of Bernheim and Whinston. One of the two markets becomes more cooperative at the expense of more competition in the other market. Does this mean that the interaction between the two markets is purely strategic? To answer this question, Phillips and Mason (2001) study firms, all of which are active on two markets but face different opponents on either market. There is no strategic reason to punish one opponent for an experience made with the other opponent, but behaviourally there could be a "mood effect" (see Phillips and Mason, 2001).

Our experimental study is motivated by the empirical analysis of Heggestad and Rhoades (1978), who found that multimarket linkages between 187 major US banking markets deterred competition. Successive empirical studies, looking at the conditions under which multimarket contacts are weakened or strengthened, have consistently shown that multimarket contacts go along with mutual forbearance. In particular, Evans and Kessides (1994) and Gimeno and Woo (1996, 1999) observed that collusive pricing is associated with multimarket contacts in the US airline industry. Parker and Röller (1997) and Busse (2000) found collusive behaviour in the US cellular telephone industry due to interdependency. Fernandez and Marrin (1998) showed effects of multimarket contracts on prices in the Spanish hotel industry and Jans and Rosenbaum (1997) in the US cement industry, respectively. Furthermore, firms with multimarket contacts are characterised by higher profits (Scott, 1982, 1991), higher survival rates (Baum and Korn, 1996, 1999), lower R&D expenditures, fewer product introductions (Vonortas, 2000; Young et al., 2000), a lower sales growth (Greve, 2008) and a lower service quality (Prince and Simon, 2009).

Data from the field make it difficult to determine a clear causality, to distinguish whether the products sold in different markets by different firms are strategic complements or substitutes and whether multimarket contacts lead to cooperation or whether successful cooperation facilitates multimarket contacts.

Our experimental study seeks to complement the theoretical and empirical studies on mutual forbearance effects. In one framework, we compare a large variety of possible links between firms, different combinations of markets for strategic substitutes and complements, and lengths of the interaction.

By representing firms as individual actors in our theoretical and experimental analysis, we abstract away the possibly complex interaction within the firm and concentrate on the interaction between firms. Of course, the usual reservation as to how much can be learned from experimental research about the "field" remains. This should, however, be discussed on a more general methodological level and not in a specific study like the present one.

Let us also discuss what it would mean to deny the forbearance hypothesis. In the spirit of mental accounting (e.g., Thaler, 1985) the absence of forbearance means that firms, when determining sales choices on one market, neglect how these choices affect results on other markets. In our view, this would be good news for competing conglomerates and would allow them to flexibly react to what happens on a specific market without engaging in global considerations of anything else. Similarly, as for antitrust policy, the absence of forbearance would justify maintaining the tradition of monitoring and regulating only specific markets instead of having to consider all markets where the same conglomerates compete.

Of course, rejecting or supporting the forbearance hypothesis should not depend on what is socially better. Our point is that forbearance effects have been claimed and that, if they exist, they would be significant. From an experimental perspective, testing the forbearance hypothesis is in itself important, independent of the experimental findings. It is not the purpose of experimental studies to confirm treatment effects. Denying treatment effects is rather good news for theorising since theorising can then neglect environmental aspects captured by the treatments.

Section 2 describes our rather general market environment, sections 3 and 4 present the experimental design and our hypotheses. Section 5 analyses the experimental data for the various treatments. Section 6 concludes and compares our findings with those of Feinberg and Sherman (1985) and others.

2. The market model

Like Feinberg and Sherman (1985) and Phillips and Mason (1992), we capture "conglomerates" by duopolistic seller firms which are strategically interacting. We distinguish 13 different treatments varying the interaction between products, the "shadow of the future", and the matching of the conglomerate firms.

Different types of interaction: It is known (see, e.g., Bester and Güth, 1998) that qualitatively different results are predicted for strategic complements than for strategic substitutes. Hence, we allow for differentiated products which may be either strategic substitutes or complements. Since the demand functions of the two firms are interdependent we will also talk about the interaction of the two firms taking place on one market. Here the term "market" only refers to a strategic interaction of firms and does not necessarily imply a similarity of the two products. First, we let both products on both markets be strategic substitutes (the case considered by Feinberg and Sherman 1985; Phillips and Mason 1992, 2001). Second, both products on both markets can be strategic complements.[1] Third, we also allow the two products on one market to be strategic substitutes and those on the other market strategic complements.

Different interaction times: Cooperative behaviour in our experiment could have several reasons. People already cooperate in one-shot situations where future pun-

[1]While in case of homogeneous products gaining in sales harms the competitor the opposite may be true for heterogeneous products.

ishement is not possible (see, e.g. Engelmann and Strobel, 2004, for a summary of different models of social preferences). Turning to finite repetitions, Kreps and Wilson (1982) point out that, if players are of different types, cooperation can be an equilibrium outcome. Indeed, laboratory experiments confirm that cooperation does emerge in finitely repeated games (e.g. Selten and Stoecker, 1986, Andreoni and Miller, 1993, Fehr and Gächter, 2000, or, more recently, Normann and Wallace, 2011). Dal Bó (2005) compares repeated games which have a fixed (and commonly known) last period with those of the same expected lengths but where the last period is determined randomly. He finds even more cooperation if there is more uncertainty about the last period.

Since cooperation in conglomerates is linked to the shadow of the future we want to compare different interaction times. Here we abstain from a discussion whether interaction of firms is better modelled as a finite or as infinite. We are only interested in comparing relative cooperation among different treatments and not in an assessment of absolute levels. Only for pragmatic reasons we compare players who are rematched every four periods with rematching every twelve periods. As it turns out we are with this parameterisation in an interesting range. Neither do we have 100% cooperation in all treatments nor do we have 0%. Instead, as we will see below, we have cooperation in 76.7% of all cases. This allows us to observe treatment effects. By varying both, multi-market structure as well as the length of the finite interaction we hope to assess the likely effects on collusion caused by each of them.

Different links between markets: We compare four different types of links between markets:

- In the baseline treatment, there are only single firms, no conglomerates (as for the baseline treatment in Phillips and Mason 1992 and Phillips and Mason 2001).
- In "homogeneous conglomerates", firms face the same opponent in both markets (as for one treatment in Feinberg and Sherman 1985 and Phillips and Mason 1992).
- In "heterogeneous conglomerates", firms face different opponents in both markets (the baseline treatment in Feinberg and Sherman 1985 and one treatment in Phillips and Mason 2001). To capture that conglomerates can be active on different markets, we employ a circle design with each firm selling on a left- and right-hand market where it competes with its left- respectively right-hand neighbour firm.
- In "asymmetric conglomerates", one conglomerate firm faces two different non-conglomerate firms to disentangle the effect of "going conglomerate" (whether a firm gains from becoming active on more than one market) and its dependence on "conglomeration" of its competitor.

Different types of markets There are two markets $m \in \{\mathfrak{a}, \mathfrak{b}\}$. In each market, there are two firms, i and j, with $(i,j) \in \{(1,2),(2,1)\}$. Quantities of firm i on market m are $q_{m,i}$. We abstract from production costs. Prices or unit profits of firm i in market m are $p_{m,i}$. The inverse demand functions are

$$p_{m,i} = a_m - b_m q_{m,i} + c_m q_{m,j} \text{ with } a_m, b_m > 0 \text{ and } |c_m| \leq 2b_m \,. \tag{1}$$

For $c_m > 0$, products of both firms are strategic complements. For $c_m < 0$, products are strategic substitutes. Profit for firm i is given by

$$\Pi_i = \sum_{m \in \{\mathfrak{a},\mathfrak{b}\}} p_{m,i} q_{m,i} \,. \tag{2}$$

As the two markets are independent, except for possible forbearance effects, the equilibrium solutions are just the combinations of the two equilibria with

$$q^*_{m,i} = \frac{a_m}{2b_m - c_m} \,. \tag{3}$$

and the individual profits of firm i

$$\Pi^*_i = \sum_{m \in \{\mathfrak{a},\mathfrak{b}\}} \frac{a_m^2 b_m}{(2b_m - c_m)^2} \,. \tag{4}$$

For the two firms competition constitutes a social dilemma. Both could do better if they would collude and chose quantities maximising the sum of profits of both firms:

$$q^+_{m,i} = \frac{a_m}{2(b_m - c_m)} . \tag{5}$$

with individual profits

$$\Pi^+_i = \sum_{m \in \{\mathfrak{a},\mathfrak{b}\}} \frac{a_m^2}{4(b_m - c_m)} \,. \tag{6}$$

Obviously, one has $q^*_{m,i} \gtrless q^+_{m,i}$ for strategic substitutes and complements, respectively; see, for instance, Suetens and Potters 2007.

3. Experimental design

Implementation: The experiment was programmed and conducted with z-Tree (Fischbacher, 2007) using an interface which allows participants to describe strategies and expectations with the help of mouse clicks. Below we will describe this interface in more detail (see also Figure 1). To recruit participants we used the electronic recruitment platform ORSEE (Greiner, 2004) which randomly allocates participants to different sessions of our experiment. ORSEE ensures that each candidate participates

Table 1 Parameters of the demand function used in the experiment

	a_m	b_m	c_m	q^*	q^+	Π^*	Π^+
substitutes	64	2	-4	8	5	128	170
complements	24	2	1	8	12	128	144

As participants choose only integer quantities in the experiment, $q^+ = 5$ for markets with strategic substitutes, and not 5 ⅓. Profits Π^* and Π^+ are only profits within one market.

only in one session of the experiment and allows us to keep the experience of our participants with this type of experiment in a similar range. The experiment took place at the experimental laboratory of the School of Economics, Friedrich Schiller University Jena, between July 2008 and July 2009. All in all, we collected 139 independent observations involving 574 participants.

Only those candidates who had passed a language test were admitted to the experiment. After the instructions were read and questions were answered in private, participants completed a quiz to make sure that they had understood the experiment. Then they took part in two times 12 periods of the actual experiment. Finally, participants completed a post-experimental questionnaire eliciting, among others, the sales strategy used.

Parameters of the demand function: We have chosen parameters with identical equilibrium profits across markets, i.e. $\Pi^*_{\mathfrak{a},i} = \Pi^*_{\mathfrak{b},i}$.[2]

Asymmetric attractiveness of the two markets—will forbearance mainly pacify the better market and lead to higher equilibrium profits?—might be a useful topic of future research. Here it has been neglected to limit the number of treatments which is unusually large anyhow. Due to the asymmetric parameters across markets, participants may not be aware that markets are equally attractive from a rational choice perspective and may actually experience them as yielding different profits.

The parameters of the demand functions used in the experiment are shown in Table 1. With these parameters, the values for sales, prices and profits are positive in equilibrium and in the cooperative outcome.

Representation of choices and payoffs: As in many other experiments with oligopoly markets, we use payoff tables to represent payoffs in the game (see the instructions in appendix B). A typical decision and feedback screen used in the experiment is shown in Figure 1. Depending on the treatment, i.e. whether participants are active on one or two markets, they see one or two tables, respectively. In each table they can choose a quantity q (between 1 and 12 and between 4 and 15 in substitute and

[2] Additionally requiring that cartel profits Π^+ be the same under the $\mathfrak{a}$ and the $\mathfrak{b}$ market would imply that $a_\mathfrak{b} = a_\mathfrak{a} \cdot \sqrt{c_\mathfrak{b}/c_\mathfrak{a}}$ and $b_\mathfrak{b} = b_\mathfrak{a} \cdot c_\mathfrak{b}/c_\mathfrak{a}$, i.e. $c_\mathfrak{a}$ must have the same sign as $c_\mathfrak{b}$. But then markets must feature either both strategic substitutes or both complements. As we want to include the situation where one market is for strategic substitutes and one for complements, we accept that cartel profits cannot always be the same.

Figure 1 Decision and feedback screen in the experiment

Period 2 remaining time [sec]: 57

Market a

quantity of the other seller (columns); quantity you are selling (rows)

	1	2	3	4	5	**6**	7	8	9	10	11	12
1	58	54	50	46	42	**38**	34	30	26	22	18	14
2	112	104	96	88	80	**72**	64	56	48	40	32	24
3	162	150	138	126	114	**102**	90	78	66	54	42	30
4	208	192	176	160	144	**128**	112	96	80	64	48	32
5	250	230	210	190	170	**150**	130	110	90	70	50	30
6	288	264	240	216	192	**168**	144	120	96	72	48	24
7	322	294	266	238	210	**182**	154	126	98	70	42	14
8	**352**	**320**	**288**	**256**	**224**	**192**	**160**	**128**	**96**	**64**	**32**	**0**
9	378	342	306	270	234	**198**	162	126	90	54	18	-18
10	400	360	320	280	240	**200**	160	120	80	40	0	-40
11	418	374	330	286	242	**198**	154	110	66	22	-22	-66
12	432	384	336	288	240	**192**	144	96	48	0	-48	-96

Market b

quantity of the other seller (columns); quantity you are selling (rows)

	4	5	6	7	**8**	9	10	11	12	13	14	15
4	80	84	88	92	**96**	100	104	108	112	116	120	124
5	90	95	100	105	**110**	115	120	125	130	135	140	145
6	96	102	108	114	**120**	126	132	138	144	150	156	162
7	98	105	112	119	**126**	133	140	147	154	161	168	175
8	96	104	112	120	**128**	136	144	152	160	168	176	184
9	90	99	108	117	**126**	135	144	153	162	171	180	189
10	**80**	**90**	**100**	**110**	**120**	**130**	**140**	**150**	**160**	**170**	**180**	**190**
11	66	77	88	99	**110**	121	132	143	154	165	176	187
12	48	60	72	84	**96**	108	120	132	144	156	168	180
13	26	39	52	65	**78**	91	104	117	130	143	156	169
14	0	14	28	42	**56**	70	84	98	112	126	140	154
15	-30	-15	0	15	**30**	45	60	75	90	105	120	135

OK

In the experiment, participants click for each market on a row and on a column to indicate their own sales quantity and what they think their partner's choice will be. Chosen rows and columns are highlighted in red. The intersection of a highlighted row and column is marked with a circle. Feedback (regarding the other player's actual quantity and the own profit) is only given after both participants have entered their choices. Knowing the two quantities, players can also look up the other player's profit in the table.

complement markets, respectively). They are also asked to predict the quantity the other player (i.e. their rival on the respective market) is going to choose. Both players decide simultaneously. After each round (and separately for each market) players receive feedback about the choices of both players and about their own payoff in this round. They can use the payoff table to obtain their competitors' profits. Providing information about the competitors' profits automatically could trigger a variety of motives like imitation dynamics or inequity aversion. Rather than implicit suggesting such motives, we left it to the participants to decide whether they are interested in their competitors' profit. Earnings are accumulated over all 24 rounds and paid in cash after the experiment using an exchange rate of 250 Experimental Currency Units (ECU)/Euro if they were active in one market and, to make sure that average earnings in Euros are comparable, an exchange rate of 500 ECU/Euro if they were active in two markets. Earnings per person were between 7.8 Euros and 18.6 Euros with an average of 12.49 Euros. Sessions usually lasted about 90 minutes.

Repetition and matching: If it can be detected, e.g. by higher than equilibrium profits or by higher profits than in the control treatment with one-market firms, forbearance may be strong initially but become less important later or vice versa. It therefore seems important to repeat the experiment often enough to render such dynamics observable. In the long term interaction, the two firms, represented by two participants, stay together over twelve rounds. Subsequently, they are matched with a new partner with whom they play the next twelve rounds. The repetition is not previously announced. But when it starts, participants are told that the experiment ends after the repetition. Similarly, in the short term interaction participants are told that they will be matched three times for four rounds with a random interaction partner. After these twelve rounds they are told that they will again be

Table 2 Treatments

treatment	type of conglomerate	matching structure	rematching every... rounds	market a	market b	independent observations	participants
1	no conglomerate	(a)	12	substitutes		8	32
2	no conglomerate	(a)	12	complements		8	32
3	no conglomerate	(a)	4	substitutes		11	44
4	no conglomerate	(a)	4	complements		8	32
5	homogeneous	(b)	12	substitutes	substitutes	12	48
6	homogeneous	(b)	12	substitutes	complements	12	48
7	homogeneous	(b)	12	complements	complements	11	44
8	homogeneous	(b)	4	substitutes	substitutes	12	48
9	homogeneous	(b)	4	substitutes	complements	12	48
10	homogeneous	(b)	4	complements	complements	12	48
11	heterogeneous	(c)	12	substitutes	complements	12	48
12	heterogeneous	(c)	4	substitutes	complements	12	48
13	asymmetric	(d)	12	substitutes	complements	9	54

The matching structure is described in detail in appendix A.

matched three times for four rounds. The matching structure for the different treatments is described in detail in appendix A. An overview of the different treatments is provided in Table 2.

Our design differs from that of Feinberg and Sherman (1985) and Phillips and Mason (1992), who performed pen-and-paper classroom sessions. Although one can easily infer other's profits from own feedback information after a round, we did not, unlike Feinberg and Sherman (1985), provide this information so as to avoid demand effects like inspiring payoff comparisons or imitation learning and other-regarding concerns. Furthermore, whereas Feinberg and Sherman (1985) explore their treatments within subjects, we employed a between subjects design throughout. All firms were run by unitary actors (one participant per firm), which excludes analysing how forbearance is related to the internal organisation of conglomerates.

4. Hypotheses

1. Forbearance:
   a) There is more cooperation in markets with conglomerate firms than in markets with single firms.

b) There is more cooperation in homogeneous than in heterogeneous conglomerates.

c) In asymmetric conglomerates, profits are larger for the conglomerate than for the single firms.

2. Other treatment effects:

a) The majority of subjects sell more than the equilibrium quantity with complements and less than the equilibrium quantity with strategic substitutes.

b) There is more cooperation in markets for strategic complements than in markets for strategic substitutes.

c) Cooperation is enhanced by a longer horizon (12 periods) than a shorter horizon (4 periods).

Hypothesis 1a might be plausible with homogeneous conglomerates where firms face the same opponent in both markets and, thus, misbehaviour in one market can be punished both in the same and in the other market.

Hypothesis 1b states that forbearance has no effects in heterogeneous conglomerates where firms face different opponents in both markets and retaliation is only possible in the same market.

Hypothesis 1c refers to asymmetric conglomerate situations where both markets are entirely independent. Still, the conglomerate firm faces a smaller amount of risk since it is operating in two markets simultaneously. This might tempt the conglomerate to act more aggressively.

From other experiments[3] we know that at the beginning of a finitely repeated game, behaviour is similar to behaviour in an infinite game. If participants treat this game as one with an infinite horizon and discount factor δ, they could follow a simple "grim" strategy, and cooperation may emerge if

$$\Pi(q^-, q^+) + \frac{\delta}{1-\delta}\Pi(q^*, q^*) \leq \frac{1}{1-\delta}\Pi(q^+, q^+)\,, \tag{7}$$

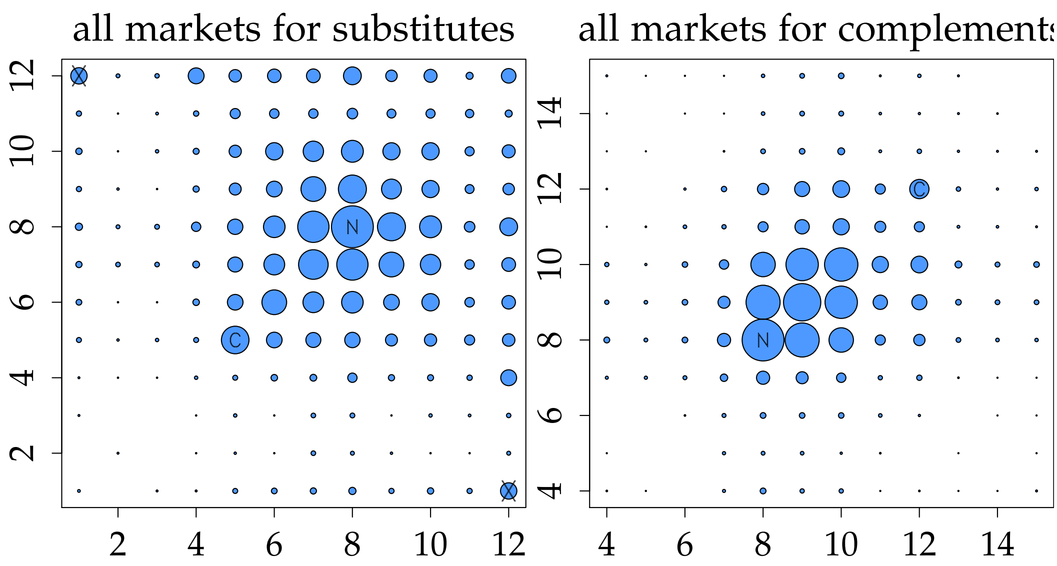
where q^- is the best reply against a cooperative opponent, q^+ the cooperative and q^* the equilibrium quantity. Bernheim and Whinston (1990) argue that cooperation is easier to obtain if inequality (7) holds even for smaller values of δ. With our parameters, the critical value for δ is $12/19 \approx 0.632$ for strategic substitutes and $9/17 \approx 0.529$ for strategic complements. Following this line of reasoning, we should expect more cooperation in markets for complements.[4] Both arguments suggest 2a and 2b.

[3]See, e.g. Selten and Stoecker (1986), Andreoni and Miller (1993), Fehr and Gächter (2000), Dal Bó (2005), Normann and Wallace (2011).

[4]Bester and Güth (1998) use an evolutionary argument and point out that, generally, in markets for strategic complements incentives are more aligned than in markets for strategic substitutes and, hence, in an evolutionary setting cooperation can be achieved more easily.

Since customers are not represented in our experiment, we neglect how differently cooperation of sellers might affect the well-being of customers.

Figure 2 Frequencies of pairs of choices



N = sym.Nash, C = sym.coop., X = asym.coop. The size (area) of the symbols is proportional to the frequencies of the choice pairs for the respective coordinates.

In the long term interaction with twelve repeated rounds players have more time to find out how their partners act than in the short term interaction with only four rounds with the same partner. In addition, punishment can be more effective with a larger number of rounds. This suggests 2c.

5. Results

5.1. Overview

Figure 2 shows frequencies of pairs of choices for all markets with strategic substitutes and complements, respectively. The size (area) of the circles is proportional to the frequency. The equilibrium is denoted by N, the symmetric cooperative outcome is denoted by C, the asymmetric cooperative outcome in markets for strategic substitutes is called X. Figures 8 and 9 in appendix C provide more details for the individual treatments.

The average profit for each market round is between −96 and 432 with an average of 129.6 ECU, slightly above the equilibrium profit of 128. Figure 3 shows the development of average profits over time during the experiment. We observe a clear end-game effect, i.e. a decrease in profits in the last round of every matching sequence. Figure 4 shows boxplots of profits for the different treatments and markets, indicating that the variance of profits is much smaller in markets for complements. Profits in conglomerates (treatments 5–13) are more heterogeneous than

Figure 3 Average profits per period

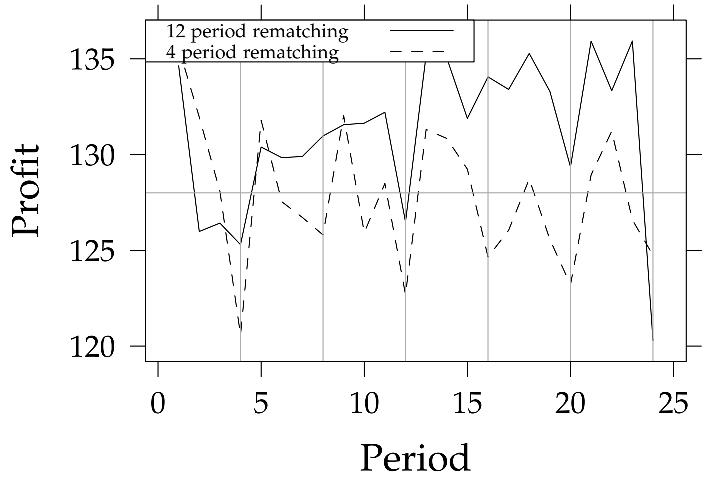
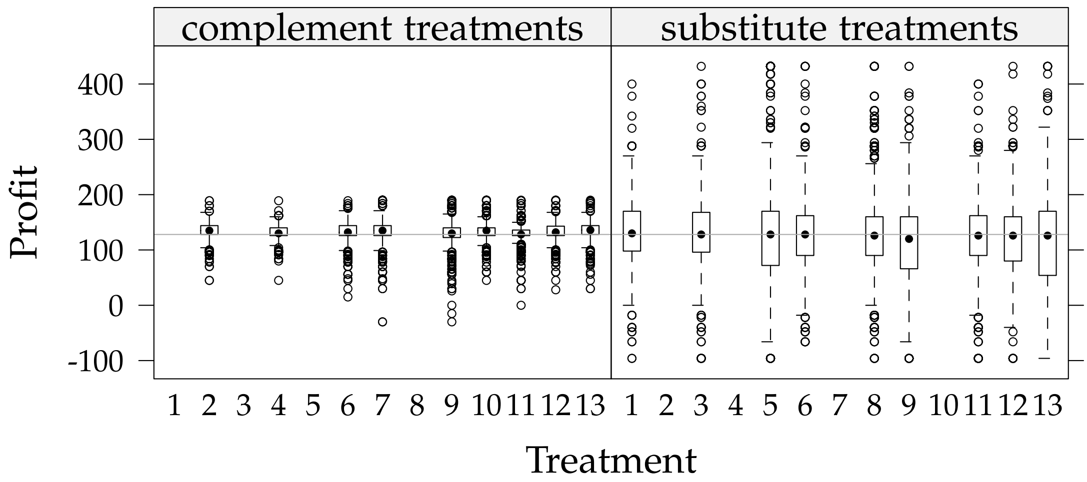


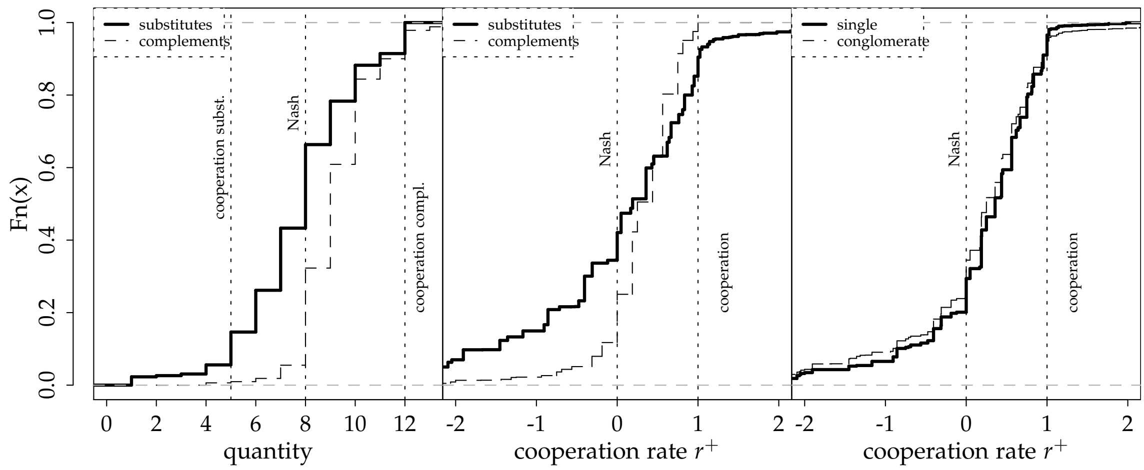
Figure 4 Profits per interaction in different treatments



in our baseline treatments (treatments 1-4).

The left part of Figure 5 illustrates the distribution of quantities separately for strategic substitutes and complements. For complements, and in line with hypothesis 2a, most quantities (67.71%) are strictly larger than the equilibrium quantity of 8. Also in line with hypothesis 2a, quantities for strategic substitutes are smaller than those for complements. However, turning to hypothesis 2b, we find less cooperation in markets for strategic substitutes: only 43.3% of all players choose quantities strictly smaller than the equilibrium levels when products are strategic substitutes.

Figure 5 Quantities and relative cooperation rates



Result 1 *Most participants clearly choose larger than equilibrium (cooperative) quantities with strategic complements. A much smaller fraction chooses smaller than equilibrium (cooperative) quantities with strategic substitutes.*

We return to this observation in a more formal context in section 5.4 below.

Cooperation rate: To measure different degrees of cooperation we define a cooperation rate (henceforth denoted as r^+):

$$r^+ = \left(\frac{\Pi(q_i, q_j) + \Pi(q_j, q_i) - 2 \cdot \Pi^*}{2 \cdot (\Pi^+ - \Pi^*)} \right) \tag{8}$$

$\Pi(q_i, q_j) + \Pi(q_j, q_i)$ is the joint profit of both players, Π^* the equilibrium profit of a single player, and Π^+ is the profit of a single player in the symmetric cooperative outcome.[5]

By definition, $r^+ = 1$ in the symmetric cooperative outcome and $r^+ = 0$ in equilibrium. In markets for strategic complements, $r^+ > 0$ requires that a player choose a quantity higher than the equilibrium quantity of 8. In markets for strategic substitutes, $r^+ > 0$ requires a quantity lower than 8. In Figure 5, the middle and right panels show the distribution of the relative cooperation rate r^+.

Result 2 *In the majority (i.e. 76.7%) of cases, the relative cooperation rate is positive ($r^+ \geq 0$).*

[5]For strategic substitutes players might actually be better off with an asymmetric cooperative outcome. This would, however, require to coordinate on alternating between two asymmetric allocations.

5.2. Aggregate cooperation and profits

In this section, we use mixed effects models to estimate average cooperation levels and average profits for the different treatments and situations. Apart from presenting some descriptives, this exercise will also facilitate understanding our estimation strategy in sections 5.3– 5.5.

Treatments: We estimate two models with mixed effects for relative cooperation r^+ and for profits Π:

$$r^+_{it} = \sum_{T \in \mathcal{T}} \beta_T d_T + \epsilon_g + \epsilon_i + \epsilon_{it} \tag{9}$$

$$\Pi_{it} = \sum_{T \in \mathcal{T}} \beta_T d_T + \epsilon_g + \epsilon_i + \epsilon_{it} \tag{10}$$

Here $\mathcal{T}$ is the set of our 13 treatments. Dummies d_T are one in treatment T and zero otherwise. For each treatment $T \in \mathcal{T}$ we estimate as β_T the average cooperation rate r^+ in equation (9) and the average profit Π in equation (10). The mixed effects model takes into account the correlation of observations in our experiment as follows: g is an index of the matching group in the experiment (independent observation), i is an index of the individual participant, and t indicates the period. In addition to the residuals ϵ_{it}, each equation includes a random effect for the matching group in the experiment ϵ_g and a random effect for the individual participant ϵ_i.[6] To exclude end-game behaviour (see Fig. 3), we drop the last period of each interaction. Estimation results are presented in Figure 6.

As expected (2c), players in long term interaction (LONG) cooperate more, in particular in homogeneous conglomerates. Likewise (2b), in all treatments there is more cooperation in the market for strategic complements than in the corresponding market for strategic substitutes.

Situations: As an extension of equations (9) and (10) and to distinguish between the different market situations within a given treatment, we estimate the following two models:

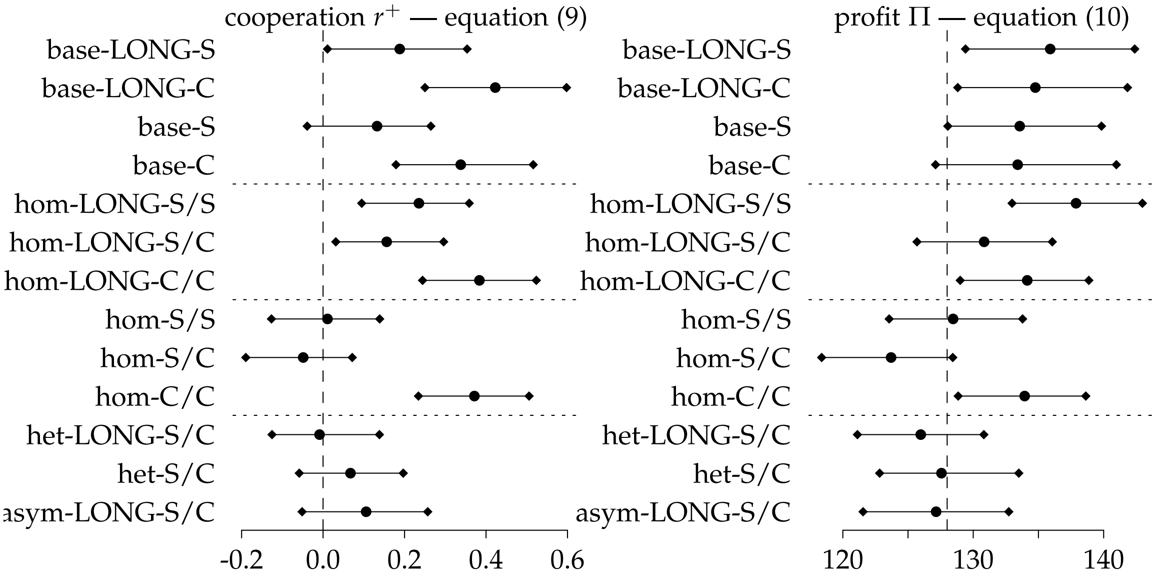
$$r^+_{it} = \sum_{S \in \mathcal{S}} \beta_S d_S + \epsilon_g + \epsilon_i + \epsilon_{it} \tag{11}$$

$$\Pi_{it} = \sum_{S \in \mathcal{S}} \beta_S d_S + \epsilon_g + \epsilon_i + \epsilon_{it} \tag{12}$$

Here $\mathcal{S}$ is the set of our 20 different situations. For each situation $S \in \mathcal{S}$ we estimate as β_S the average cooperation rate r^+ in equation (11) and the average profit Π in equation (12). The mixed effects are the same as in equation (9) and (10). Again we drop the last period of each interaction to exclude end-game behaviour. Figure 7 shows estimated coefficients and confidence intervals.

[6]Mixed effects models are estimated with lme4 version 0.999999-2 (2013-04-09). HPD confidence intervals and significance levels are based on bootstraps with 1000 replications.

Figure 6 Cooperation and profit in the different treatments



Each line shows the range of the 95% HPD (highest posterior density) confidence interval, based on 1000 bootstrap replications. The larger dot is the parameter estimate of the coefficient for this treatment. Different links between markets are denoted "base","hom","het" and "asym" for the baseline, homogeneous, heterogeneous and asymmetric conglomerate. The long term interaction (12 rounds) is denoted as "LONG". Markets for strategic substitutes are called "S", those for strategic complements are called "C".

Our experiment has shown that in all situations the firms which operate in a mix of strategic complement and substitute markets cooperate less than the firms where both markets are of the same type. This is an important observation for our analysis below. To establish this formally, we estimate the following model only for homogeneous conglomerates:

$$r^+_{it} = \beta_{\text{mixed}} \cdot d_{\text{mixed}} + \beta_{\text{long}} \cdot d_{\text{long}} + \beta_{\text{subs}} \cdot d_{\text{subs}} + \epsilon_g + \epsilon_i + \epsilon_{it} \quad (13)$$

$$\Pi_{it} = \beta_{\text{mixed}} \cdot d_{\text{mixed}} + \beta_{\text{long}} \cdot d_{\text{long}} + \beta_{\text{subs}} \cdot d_{\text{subs}} + \epsilon_g + \epsilon_i + \epsilon_{it} \quad (14)$$

Estimation results are shown in Table 3. We note that the coefficient of "mixed" is highly significant.

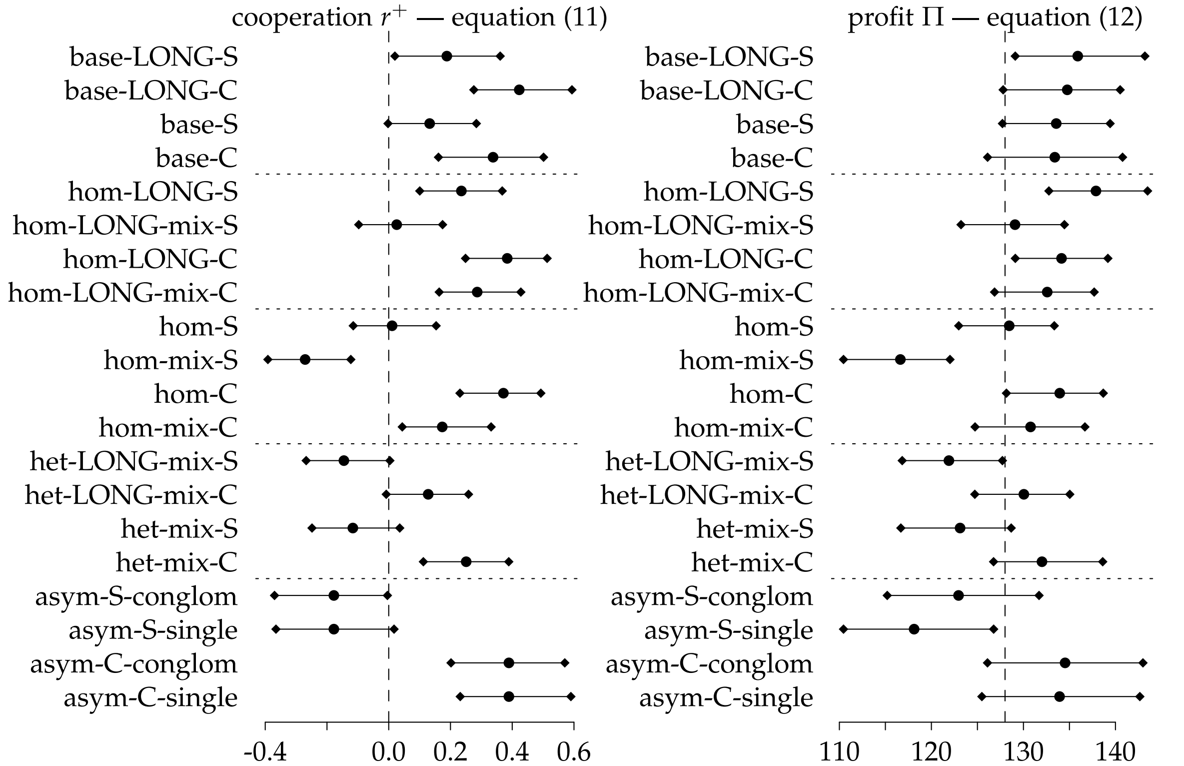
Result 3 (Mixed markets) *Rates of cooperation and profits on a given market are lower if the two markets are of different types (one market for strategic substitutes, the other for complements).*

Thus, when we compare conglomerates with our baseline treatments (which can never be "mixed") we exclude mixed situations.

5.3. Forbearance

Conglomerates and non-conglomerates: We estimate the following (only for baseline and homogeneous conglomerates, leaving the mixed situations and the end-games

Figure 7 Cooperation and profit in different market situations



See also the notes below Figure 6. If the other market is of a different type (e.g. for strategic complements if this market is for strategic substitutes), we denote this situation as "mix". In the asymmetric treatment, we denote the conglomerate as "conglom" and the single firm as "single".

Table 3 Mixed markets

	cooperation — eq. (13)		profit — eq. (14)	
(Intercept)	0.343***	[0.255; 0.446]	133.828***	[129.951; 137.879]
mixed	−0.199**	[−0.315; −0.068]	−6.426**	[−11.205; −1.479]
long	0.150**	[0.043; 0.267]	5.737*	[1.328; 9.985]
subs	−0.332***	[−0.378; −0.275]	−5.972***	[−9.209; −2.956]
AIC	29777.801		125294.713	
N	11344		11344	

Stars denote the following significance levels: ***=.001, **=.01, *=.05, $^+$=.1. 95% HPD (highest posterior density) confidence intervals are given in brackets. The estimation includes only data from homogeneous conglomerates.

aside):

$$r^+_{it} = \beta_{\text{homcon}} \cdot d_{\text{homcon}} + \beta_{\text{long}} \cdot d_{\text{long}} + \beta_{\text{subs}} \cdot d_{\text{subs}} + \epsilon_g + \epsilon_i + \epsilon_{it} \quad (15)$$

$$\Pi_{it} = \beta_{\text{homcon}} \cdot d_{\text{homcon}} + \beta_{\text{long}} \cdot d_{\text{long}} + \beta_{\text{subs}} \cdot d_{\text{subs}} + \epsilon_g + \epsilon_i + \epsilon_{it} \quad (16)$$

Results are shown in Table 4. According to hypothesis 1a, we should find more cooperation and higher profits in markets with conglomerate firms than in markets

Table 4 Conglomerates versus non-conglomerates

	cooperation — eq. (15)		profit — eq. (16)	
(Intercept)	0.343^{***}	$[0.232; 0.448]$	132.719^{***}	$[127.723; 137.761]$
homcon	-0.022	$[-0.132; 0.078]$	-0.822	$[-5.240; 3.752]$
long	0.099^{+}	$[-0.005; 0.209]$	3.740^{+}	$[-0.300; 8.216]$
subs	-0.240^{***}	$[-0.339; -0.129]$	-0.235	$[-4.306; 4.184]$
AIC	26532.349		113477.379	
N	10280		10280	

Stars denote the following significance levels: ***=.001, **=.01, *=.05, $^{+}$=.1. 95% HPD (highest posterior density) confidence intervals are given in brackets. The estimation includes only data from homogeneous conglomerates and the baseline treatments. Mixed markets are excluded.

with single firms. We cannot confirm this hypothesis. Rather, we find a negative (though not significant) effect. In any case, if we compare the magnitude of the "conglomerate" effect (-0.022) with the intercept (0.343), i.e. the cooperation rate of firms on a market for complements, we note that the conglomerate effect is very small.

Result 4 *Conglomerate firms cooperate insignificantly less than firms only active in one market.*

We will explain and discuss these surprising results in section 6.

Homogeneous and heterogeneous conglomerates: One could argue that the comparison of conglomerates with single firms in equations (15) and (16) is not adequate. Perhaps our participants found the task easier in the baseline treatment since participants could concentrate on a single market and, thus, more easily reap the fruits of cooperation. It would be more adequate to compare homogeneous with heterogeneous conglomerates. This would be a clean test of the forbearance hypothesis since no forbearance effect is possible in heterogeneous conglomerates: partners in the $\mathfrak{a}$ market know that they both have different partners in the $\mathfrak{b}$ market.

Hence, in a next step we compare homogeneous with heterogeneous conglomerates. Since in the heterogeneous conglomerates we have only mixed markets (one for strategic substitutes, the other for complements), we restrict our analysis to this market type. We estimate the following equation:

$$r_{it}^{+} = \beta_{\text{hetcon}} \cdot d_{\text{hetcon}} + \beta_{\text{long}} \cdot d_{\text{long}} + \beta_{\text{subs}} \cdot d_{\text{subs}} + \epsilon_g + \epsilon_i + \epsilon_{it} \quad (17)$$

$$\Pi_{it} = \beta_{\text{hetcon}} \cdot d_{\text{hetcon}} + \beta_{\text{long}} \cdot d_{\text{long}} + \beta_{\text{subs}} \cdot d_{\text{subs}} + \epsilon_g + \epsilon_i + \epsilon_{it} \quad (18)$$

Results are shown in Table 5. According to hypothesis 1b, we should find more cooperation in homogeneous than in heterogeneous conglomerates. If there is a forbearance effect, we can expect to find it here. Indeed, the coefficient of "hetcon" has the right sign, but the value is not significant and very small (-0.026)—much smaller than anything else that plays a role here.

Table 5 Heterogeneous versus homogeneous conglomerates

	cooperation — eq. (17)		profit — eq. (18)	
(Intercept)	0.187^{**}	$[0.070; 0.316]$	130.129^{***}	$[126.086; 134.167]$
hetcon	-0.026	$[-0.150; 0.115]$	-0.605	$[-5.413; 4.069]$
long	0.064	$[-0.076; 0.194]$	2.771	$[-1.864; 7.510]$
subs	-0.329^{***}	$[-0.369; -0.288]$	-8.385^{***}	$[-10.543; -6.172]$
AIC	20297.094		82336.325	
N	7680		7680	

Stars denote the following significance levels: ***=.001, **=.01, *=.05, $^{+}$=.1. 95% HPD (highest posterior density) confidence intervals are given in brackets. The estimation includes only data from mixed markets of homogeneous and heterogeneous conglomerates.

Table 6 Single firms versus conglomerate firms

(Intercept)	135.048^{***}	$[124.231; 146.273]$
asymSingle	-2.715	$[-15.238; 9.154]$
subs	-12.619^{**}	$[-19.982; -5.240]$
AIC	17656.645	
N	1584	

Stars denote the following significance levels: ***=.001, **=.01, *=.05, $^{+}$=.1. 95% HPD (highest posterior density) confidence intervals are given in brackets. The estimation includes only data from asymmetric conglomerates.

Result 5 *We do not find significantly more cooperation in homogeneous than in heterogeneous conglomerates if we restrict ourselves to "pure" markets (both strategic substitutes or both complements).*

Conglomerates and single firms: According to hypothesis 1c, we should expect relatively larger profits of the conglomerate and smaller profits of the single firms. Since the rate of cooperation is the same for both firms, the single firm and the conglomerate, we can only estimate the equation for profits:

$$\Pi_{it} = \beta_{\text{asymSingle}} \cdot d_{\text{asymSingle}} + \beta_{\text{subs}} \cdot d_{\text{subs}} + \epsilon_g + \epsilon_i + \epsilon_{it} \tag{19}$$

Results are shown in Table 6. We note that the effect of being a single firm has the expected sign, i.e. it is negative and -2.715, but the effect is not significant.

5.4. Other treatment effects

According to hypothesis 2b, we should find more cooperation in markets for strategic complements than in markets for strategic substitutes. Indeed, β_{subs} is highly significant and negative in equations (15)–(19).

Result 6 *We find more cooperation and higher profits in markets for strategic complements than in markets for strategic substitutes.*

According to hypothesis 2c we should find more cooperation in treatments with long term interaction. Indeed, the coefficient β_{long} has the correct sign in equations (15)–(18), although it is not significant.

Result 7 *There is slightly more cooperation in treatments with long term interaction (matching for twelve periods) than in treatments with short term interaction (four periods).*

5.5. Market Interaction: Reciprocity and Learning

Above, in sections 5.2–5.4, we have studied aggregate levels of cooperation. In this section, we analyse the forces behind individual behaviour.

Bernheim and Whinston (1990) provide a theoretical model of equilibria in homogeneous conglomerates. They argue that the efficiency of punishment and reward may differ between different markets. Within one homogeneous conglomerate, the market with the more efficient technology for punishment and reward can be used to support cooperation in the other market.

Phillips and Mason (2001) provide an experimental study of heterogeneous conglomerates. Of course, there is no strategic reason to punish or reward one firm for what another firm did in another market. However, players could still learn from one market how to behave in the other.

We distinguish two main motives:

- A firm optimises myopically and adjusts the own quantity toward a best reply to the opponent's behaviour $q_{j,t-1}$ in the previous period

$$\Delta x_t^{\text{BR}} = \frac{a + cq_{j,t-1}}{2b} - q_{i,t-1} \tag{20}$$

  or toward a best reply to the expected opponent's behaviour $q_{j,t}^E$ in the current period (note that we observe expectations in our experiment).

$$\Delta x_t^{\text{BR|E}} = \frac{a + cq_{j,t}^E}{2b} - q_{i,t-1} \tag{21}$$

- A firm could try to teach the opponent by punishing misbehaviour or rewarding kindness. This is costly in the short run but might lead to higher profits in the future. To make our different market situations more comparable, we define the misbehaviour or kindness of player j as a change in the (potential) profits player i could obtain if player i played a best reply. The best profit player i could obtain, given the behaviour of player j, is

$$\Pi_{i,t}^{\text{BR}} = \frac{(a + cq_{j,t})^2}{4b}. \tag{22}$$

  Reward or punishment work differently in markets for strategic substitutes than in markets for strategic complements. Player j gains from a unit-change in the quantity of player i the amount $c \cdot q_j$. We define the strategic incentive to change the own quantity as

$$\dot{\pi}_{t-1} = \frac{1}{c}\left(\Pi^{\text{BR}}_{i,t-1} - \Pi^{\text{BR}}_{i,t-2}\right) . \tag{23}$$

For reactions to changes in the other market we define $\dot{\pi}^{\text{O}}_{t-1}$ accordingly. Lagged versions of this variable will be $\dot{\pi}_{t-2}$, $\dot{\pi}_{t-3}$, etc.[7]

We define

$$\begin{aligned}
X^{\text{BR}} &\equiv \Delta x^{\text{BR|E}}_t \cdot (\beta_1 d_{\text{sub}} + \beta_2 d_{\text{com}}) + \Delta x^{\text{BR}}_t \cdot (\beta_3 d_{\text{sub}} + \beta_4 d_{\text{com}}) && (24)\\
X^{\text{SAME}} &\equiv \sum_{l=1}^{3} (\gamma^{\text{S}}_l d_{\text{sub}} + \gamma^{\text{C}}_l d_{\text{com}}) \dot{\pi}_{t-l} && (25)\\
X^{\text{SC/CS}} &\equiv \sum_{l=1}^{3} (\gamma^{\text{SC}}_l d_{\text{sub}} d^{\text{O}}_{\text{com}} + \gamma^{\text{CS}}_l d_{\text{com}} d^{\text{O}}_{\text{sub}}) \dot{\pi}^{\text{O}}_{t-l} && (26)\\
X^{\text{SS/CC}} &\equiv \sum_{l=1}^{3} (\gamma^{\text{SS}}_l d_{\text{sub}} d^{\text{O}}_{\text{sub}} + \gamma^{\text{CC}}_l d_{\text{com}} d^{\text{O}}_{\text{com}}) \dot{\pi}^{\text{O}}_{t-l} . && (27)
\end{aligned}$$

Here X^{BR} captures the tendency to play a best reply, X^{SAME} captures reciprocity on the same market, $X^{\text{SC/CS}}$ captures reciprocity toward an other market of a different type, and $X^{\text{SS/CC}}$ captures reciprocity toward another market of the same type. The dummies d_{sub} and d_{com} are one in markets for strategic substitutes and complements, respectively. The dummies $d^{\text{O}}_{\text{sub}}$ and $d^{\text{O}}_{\text{com}}$ are one if the other market is one for strategic substitutes and complements, respectively. β and γ are the coefficients we will estimate in the following three equations with random effects for participants ϵ_i and matching groups ϵ_g for the baseline (28), the homogeneous (29) and the heterogeneous (as well as the asymmetric) conglomerate (30):

$$\begin{aligned}
\Delta x_t &= \beta_0 + X^{\text{BR}} + X^{\text{SAME}} + \epsilon_g + \epsilon_i + \epsilon_{it} && (28)\\
\Delta x_t &= \beta_0 + X^{\text{BR}} + X^{\text{SAME}} + X^{\text{SC/CS}} + X^{\text{SS/CC}} + \epsilon_g + \epsilon_i + \epsilon_{it} && (29)\\
\Delta x_t &= \beta_0 + X^{\text{BR}} + X^{\text{SAME}} + X^{\text{SC/CS}} + \epsilon_g + \epsilon_i + \epsilon_{it} && (30)
\end{aligned}$$

Estimation results are shown in Tables 7 and 8.

We make the following observations:

1. The main motive for choices in all situations is to best reply. The coefficients for the best replies to expectations $\Delta x^{\text{BR|E}}_t$ as well as for the best replies to the past choice of the opponent Δx^{BR}_t are highly significant for markets with strategic substitutes as well as for markets with strategic complements.

[7] We also ran regressions with fewer lags and obtained similar results.

Table 7 Estimation of equations (28), (29) and (30)

	baseline		homogeneous		heterogeneous	
(Intercept)	-0.111	$[-0.391; 0.158]$	-0.036	$[-0.173; 0.096]$	0.070	$[-0.052; 0.193]$
$\Delta x_t^{\mathrm{BR\|E}} d_{\mathrm{sub}}$	0.263^{***}	$[0.208; 0.314]$	0.266^{***}	$[0.241; 0.286]$	0.058^{**}	$[0.018; 0.098]$
$\Delta x_t^{\mathrm{BR\|E}} d_{\mathrm{com}}$	1.756^{***}	$[1.466; 2.105]$	1.256^{***}	$[1.120; 1.381]$	1.394^{***}	$[1.198; 1.588]$
$\Delta x_t^{\mathrm{BR}} d_{\mathrm{sub}}$	0.382^{***}	$[0.311; 0.446]$	0.286^{***}	$[0.260; 0.312]$	0.413^{***}	$[0.363; 0.463]$
$\Delta x_t^{\mathrm{BR}} d_{\mathrm{com}}$	-0.801^{***}	$[-1.143; -0.495]$	-0.533^{***}	$[-0.660; -0.402]$	-0.672^{***}	$[-0.845; -0.475]$
$\dot{\pi}_{t-1} d_{\mathrm{sub}}$	0.051^{***}	$[0.043; 0.058]$	0.025^{***}	$[0.022; 0.028]$	0.028^{***}	$[0.022; 0.034]$
$\dot{\pi}_{t-1} d_{\mathrm{com}}$	0.022^{***}	$[0.012; 0.033]$	0.013^{***}	$[0.009; 0.018]$	0.014^{***}	$[0.006; 0.020]$
$\dot{\pi}_{t-2} d_{\mathrm{sub}}$	0.035^{***}	$[0.027; 0.041]$	0.016^{***}	$[0.013; 0.019]$	0.017^{***}	$[0.011; 0.023]$
$\dot{\pi}_{t-2} d_{\mathrm{com}}$	0.016^{**}	$[0.005; 0.026]$	0.006^{**}	$[0.002; 0.012]$	0.007^{*}	$[0.000; 0.014]$
$\dot{\pi}_{t-3} d_{\mathrm{sub}}$	0.023^{***}	$[0.018; 0.028]$	0.009^{***}	$[0.006; 0.011]$	0.013^{***}	$[0.008; 0.018]$
$\dot{\pi}_{t-3} d_{\mathrm{com}}$	0.013^{**}	$[0.003; 0.022]$	0.007^{**}	$[0.002; 0.010]$	0.003	$[-0.004; 0.009]$
$\dot{\pi}^{\mathrm{O}}_{t-1} d^{\mathrm{O}}_{\mathrm{sub}} d_{\mathrm{sub}}$			0.007^{***}	$[0.004; 0.010]$		
$\dot{\pi}^{\mathrm{O}}_{t-1} d^{\mathrm{O}}_{\mathrm{com}} d_{\mathrm{sub}}$			0.036^{***}	$[0.013; 0.062]$	0.022	$[-0.006; 0.045]$
$\dot{\pi}^{\mathrm{O}}_{t-1} d^{\mathrm{O}}_{\mathrm{sub}} d_{\mathrm{com}}$			0.001	$[-0.000; 0.002]$	0.000	$[-0.001; 0.001]$
$\dot{\pi}^{\mathrm{O}}_{t-1} d^{\mathrm{O}}_{\mathrm{com}} d_{\mathrm{com}}$			0.006^{*}	$[0.001; 0.011]$		
$\dot{\pi}^{\mathrm{O}}_{t-2} d^{\mathrm{O}}_{\mathrm{sub}} d_{\mathrm{sub}}$			0.006^{***}	$[0.003; 0.009]$		
$\dot{\pi}^{\mathrm{O}}_{t-2} d^{\mathrm{O}}_{\mathrm{com}} d_{\mathrm{sub}}$			0.013	$[-0.011; 0.041]$	0.018	$[-0.009; 0.045]$
$\dot{\pi}^{\mathrm{O}}_{t-2} d^{\mathrm{O}}_{\mathrm{sub}} d_{\mathrm{com}}$			0.000	$[-0.001; 0.001]$	0.000	$[-0.001; 0.001]$
$\dot{\pi}^{\mathrm{O}}_{t-2} d^{\mathrm{O}}_{\mathrm{com}} d_{\mathrm{com}}$			0.001	$[-0.006; 0.007]$		
$\dot{\pi}^{\mathrm{O}}_{t-3} d^{\mathrm{O}}_{\mathrm{sub}} d_{\mathrm{sub}}$			0.006^{***}	$[0.003; 0.009]$		
$\dot{\pi}^{\mathrm{O}}_{t-3} d^{\mathrm{O}}_{\mathrm{com}} d_{\mathrm{sub}}$			0.016	$[-0.005; 0.040]$	-0.005	$[-0.029; 0.023]$
$\dot{\pi}^{\mathrm{O}}_{t-3} d^{\mathrm{O}}_{\mathrm{sub}} d_{\mathrm{com}}$			0.001	$[-0.000; 0.002]$	-0.001	$[-0.002; 0.001]$
$\dot{\pi}^{\mathrm{O}}_{t-3} d^{\mathrm{O}}_{\mathrm{com}} d_{\mathrm{com}}$			-0.001	$[-0.007; 0.004]$		
AIC	9062.709		36825.574		12697.760	
N	2292		9360		3168	

2. Reciprocity (the coefficients of $\dot{\pi}$) is strong and significant for both strategic complements and substitutes. Players seem to have long memories. Even the third lag is still significant and has the expected sign.

3. We find significant reciprocity across markets in homogeneous conglomerates, particularly toward markets for strategic substitutes.

4. We find little reciprocity across markets with heterogeneous or asymmetric conglomerates.

Point 3 is in line with Bernheim and Whinston (1990) who predicted the punishment technology of markets for strategic substitutes to be slightly weaker and, hence, in need of 'help' from other markets. It is worth noting that this 'help' is stronger if the other market is for strategic substitutes. In Figure 8 in Appendix C we see that markets of homogeneous conglomerates for strategic substitutes are typically divided among players. This division of power requires coordination across markets, which is also in line with the positive and significant coefficients of $\dot{\pi}^{\mathrm{O}}$ in equation (29) where both markets are for strategic substitutes.

Table 8 Estimation of equations (30) for asymmetric conglomerates

	asym. conglom.		asym. single	
(Intercept)	-0.247	$[-0.596; 0.131]$	0.083	$[-0.354; 0.434]$
$\Delta x_t^{BR\|E} d_{sub}$	0.152^{***}	$[0.078; 0.224]$	0.277^{***}	$[0.185; 0.356]$
$\Delta x_t^{BR\|E} d_{com}$	0.855^{***}	$[0.503; 1.250]$	1.367^{***}	$[0.784; 1.964]$
$\Delta x_t^{BR} d_{sub}$	0.260^{***}	$[0.161; 0.345]$	0.456^{***}	$[0.326; 0.556]$
$\Delta x_t^{BR} d_{com}$	-0.473^{*}	$[-0.843; -0.105]$	-0.713^{*}	$[-1.320; -0.153]$
$\dot{\pi}_{t-1} d_{sub}$	0.038^{***}	$[0.025; 0.050]$	0.054^{***}	$[0.038; 0.070]$
$\dot{\pi}_{t-1} d_{com}$	0.019^{*}	$[0.001; 0.038]$	0.017^{+}	$[-0.002; 0.038]$
$\dot{\pi}_{t-2} d_{sub}$	0.026^{***}	$[0.013; 0.039]$	0.044^{***}	$[0.028; 0.057]$
$\dot{\pi}_{t-2} d_{com}$	0.012	$[-0.006; 0.032]$	0.009	$[-0.010; 0.031]$
$\dot{\pi}_{t-3} d_{sub}$	0.007	$[-0.001; 0.017]$	0.024^{***}	$[0.012; 0.034]$
$\dot{\pi}_{t-3} d_{com}$	-0.000	$[-0.018; 0.017]$	0.016	$[-0.002; 0.036]$
$\dot{\pi}_{t-1}^{O} d_{sub}$	-0.039	$[-0.105; 0.029]$		
$\dot{\pi}_{t-1}^{O} d_{com}$	-0.001	$[-0.003; 0.002]$		
$\dot{\pi}_{t-2}^{O} d_{sub}$	0.007	$[-0.068; 0.080]$		
$\dot{\pi}_{t-2}^{O} d_{com}$	-0.000	$[-0.003; 0.002]$		
$\dot{\pi}_{t-3}^{O} d_{sub}$	0.011	$[-0.054; 0.083]$		
$\dot{\pi}_{t-3}^{O} d_{com}$	-0.001	$[-0.004; 0.001]$		
AIC	2866.147		2844.299	
N	648		648	

Result 8 *We find reciprocity across markets in homogeneous conglomerates, particularly in markets for strategic substitutes.*

Point 4 is also in line with Bernheim and Whinston (1990). There is no strategic reason to find indirect reciprocity here. However, Phillips and Mason (2001) observe that players learn across markets. In their experiment, both markets are for strategic substitutes and learning is straightforward. In our treatment with heterogeneous conglomerates, one market is for strategic substitutes and the other for strategic complements. In our experiment, we observe lower cooperation rates in mixed markets (see result 3) where it is certainly more difficult for participants to relate past results of one market to what they should do on the other market. This might explain why we observe no relation between the two markets in heterogeneous and asymmetric conglomerates.

Result 9 *In the case of heterogeneous conglomerates, we cannot reject independence of markets.*

6. Conclusions

To test the forbearance hypothesis, we performed a systematic experimental analysis. We allowed for differentiated products in the form of strategic substitutes as well as complements, we distinguished infrequent and frequent rematching, and we ran several control treatments with different types of links between markets.

Before summarising our own findings, let us briefly review some experimental forbearance effects. Feinberg and Sherman (1985), whose theoretical analysis is based on a conjectural variation approach, consider markets which are identical in terms of demand and cost conditions, enabling them to measure competitiveness by the sum of sales amounts. Within these otherwise identical markets, they compare the case of "homogeneity" (in the sense of (non-)conglomerates facing (non-)conglomerates) with that of heterogeneity in market participation. They find only a small and insignificant treatment effect. However, they do find a significantly larger variance with homogeneous conglomerates, which might be taken as an indication of active reciprocal behaviour across markets.

Phillips and Mason (1992) compare homogeneous conglomerates with single firms (our baseline treatment). Since their two markets are asymmetric, there is room for one market to 'help' the other in a conglomerate. Phillips and Mason find, indeed, that "conglomeration tends to reduce cooperation in markets where cooperation is relatively easy, and [. . .] tends to increase cooperation in markets where cooperation is relatively difficult." Phillips and Mason (2001) study heterogeneous conglomerates, i.e. conglomerates where no strategic motives exist to punish or reward an opponent in one market for what happened in the other, and find that players learn from experience in one market how to behave in the other.

The results of our experiment confirm the standard hypotheses: Participants behave more cooperatively than the predicted equilibrium benchmark, there is more cooperation in the market for strategic complements than in one for substitutes and less cooperation in frequent than in infrequent rematching.

We also find support for the theoretical driving forces of cooperation in conglomerates. In line with Bernheim and Whinston (1990), markets in homogeneous conglomerates are behaviourally linked. We find no such interaction in heterogeneous conglomerates, i.e. in markets where there is no strategic reason for behavioural spillovers. In contrast to Phillips and Mason (2001), learning does not seem to play a role in our conglomerates where markets differ sufficiently.

One surprising result is that conglomerate firms do not cooperate more than single firms. Thus, at least in our experiment conglomerates do not have anti-competitive effects. From this perspective of antitrust policy our results could be seen as comforting: the existence of conglomerate firms per se does not justify intervention, and a careful monitoring of such markets may be sufficient. Actually, conglomerates seem to enhance competition significantly in mixed markets. The mere presence of a second and sufficiently different market stimulates competition. One reason could be leapfrogging, i.e. increased competition by those lagging behind, for instance in accumulated profits (see, e.g., Cantner et al., 2009). A firm which is less successful on one market might try to "win" the other market.

Of course, such behaviour can more easily evolve over time. In our experiment, this could occur when one conglomerate is dominating one market—in the sense that market results would be disastrous if the other firm sold the same amount as the dominating firm. If on the other market both conglomerates sell similar amounts, the disadvantaged firm might try to dominate the other market. Thus, any strong disparity on one market can easily initiate a process of alternating attempts to dominate at least one market, resulting in lower than equilibrium profits.

Identifying anti-competitive effects caused by multimarket firms is difficult when firms are more complex. The complexity of multimarket firms is, for instance, reflected in the internal organisation between the headquarter and its subsidiaries as well as between factor and product markets. Thus, in firms with weak internal coordination, the headquarter is unable to pose credible threats of retaliation to aggressive moves made by global multimarket firms against its subsidiaries. We excluded this scenario by assuming a unitary actor also for conglomerate firms as in neo-classical economics. In this way, we have been able to illustrate how experiments such as ours allow testing the mutual forbearance hypothesis with respect to multimarket contact in a stylised setting where certain aspects are excluded without necessarily denying their relevance in the field.

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A. Experimental Setup

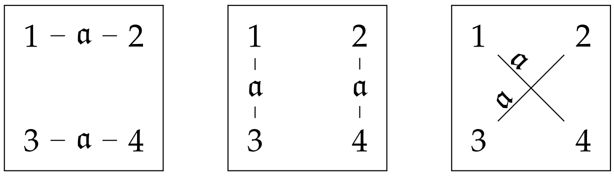
We have relied on matching groups with four participants each in all treatments except for treatment 13 where conglomerate firms interact with single firms on the same markets. There we have matching groups of six.

We study the following settings both in a long term and in a short term interaction setting (with the exception of the asymmetric markets case). In the long term setting we first play a game with one of these matchings for the first 12 rounds. Then another game is announced, again for 12 rounds, where we use another matching.

In the short term interaction setting we switch among the following matchings every four rounds. We announce a new game after 12 rounds both in the long term and in the short term treatment to avoid as far as possible any biases between the long term and the short term design.

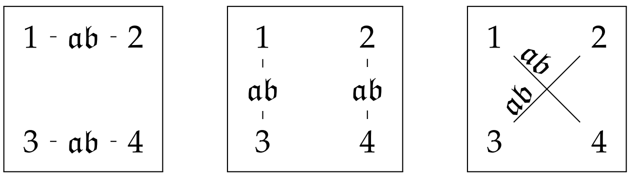
Participants are not aware of the small size of the matching group. All they know is that pairs are randomly formed in every four or in every twelve rounds.

Baseline treatment—no conglomerates: In our baseline treatment there are no conglomerates. The strategic interaction takes place only on a single market. If we write markets $\mathfrak{a}$ (and later $\mathfrak{b}$) next to connections between the four members of a matching group, then matching in the baseline treatments follows these three structures:



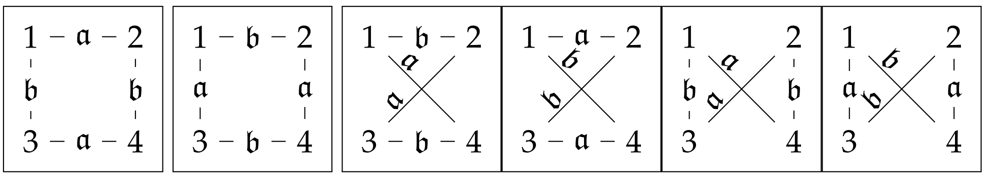
[a]

Homogeneous conglomerates: In the homogeneous conglomerate treatment (treatments 5-10), pairs of firms (denoted with numbers) simultaneously interact on two markets, $\mathfrak{a}$ and $\mathfrak{b}$, using the following matchings:



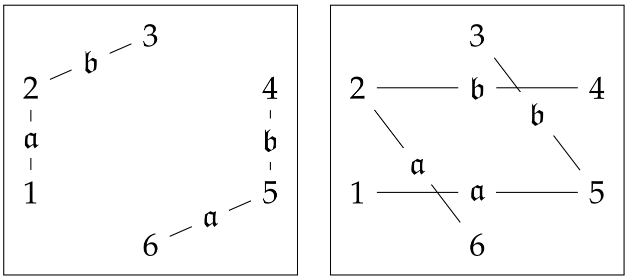
[b]

Heterogeneous conglomerates: When conglomerates are supposed to compete with two different conglomerates on both markets we use matchings as follows:



[c]

Asymmetric markets with conglomerates and single firms: When conglomerates are supposed to compete with non-conglomerates, each matching group of six participants contained two conglomerates and four "one market-firms", one for the $\mathfrak{a}$-market and one for the $\mathfrak{b}$-market for each conglomerate firm. Here we only ran a long term design with two sessions containing 3 matching groups each, i.e. with 36 participants (treatment 13).



[d]

A design with short term interaction would have required larger matching groups what might have questioned the comparability of the results across treatments.

Substitutes and complements: Interaction on the above markets might depend on whether products are strategic substitutes or complements. For the baseline treatment [a] without conglomerates (treatments 1-4) and the homogeneous conglomerates (treatments 5-10, [b]) we study all possible combinations. The case of heterogeneous conglomerates (treatments 11 and 12, [c]) and the case of conglomerates and single firms (treatment 13, [d]) is only studied in one setting each: products on the $\mathfrak{a}$-market are strategic substitutes, products on the $\mathfrak{b}$-market are strategic complements (again, see Table 2).

B. Experimental Instructions

Here we present the translation of the originally German instructions for treatment 6 (long term interaction, homogeneous conglomerates, strategic substitute and complement markets). The instructions for the other treatments differ only where necessary. In the experiment markets were called X and Y. To be consistent with the notation we use in the paper we use $\mathfrak{a}$ *and* $\mathfrak{b}$ *in the following.*

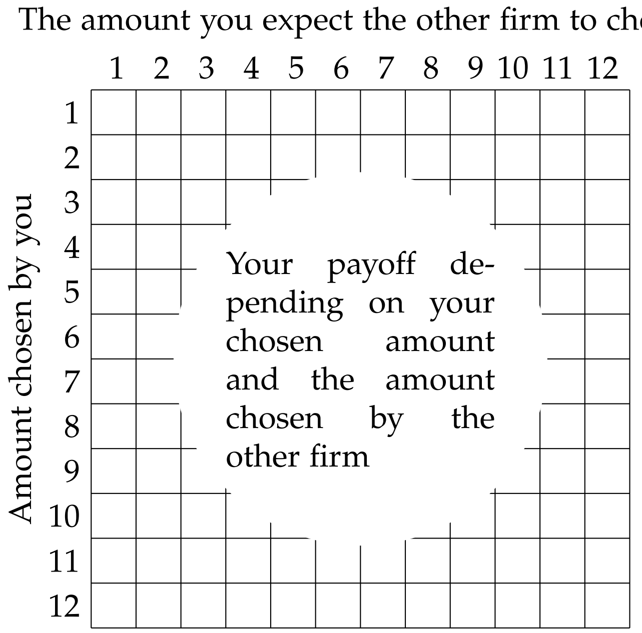
Welcome to this experiment and thank you for participating!

You can earn money in this experiment; the amount will depend on your own decisions and on the decisions of the other participants. *Therefore, it is very important that you read these instructions carefully.*

If you have any questions, please raise your hand. We will come to your seat and answer your questions. Please do not ask your questions out loud. All participants of this experiment are given the same instructions, whereas the information that appears on the computer screen during the game is for the respective participant only. That is why you are *not allowed to look at the screens of the other participants or talk to them during the experiment*. Non-compliance with these rules will result in your exclusion from the experiment. Please switch off your mobile phones now.

In the following experiment you will play together with one partner. You and your partner represent two firms each. These firms are active in the same markets, namely market $\mathfrak{a}$ and market $\mathfrak{b}$. Your task is to determine the sales volume of your firms in these markets. Your partner's task is to determine the sales volume of his/her firms

Table 9 Example payoff chart from the instructions.



in the same markets. Each of his/her firms will be confronted with one of your firms.

Your firm 1	market 𝔞 ⟷	Partner's firm 1
Your firm 2	market 𝔟 ⟷	Partner's firm 2

You will play the following twelve rounds with the same partner.

During the experiment you will see charts on the screen. In these charts you can see how your decision and the decision of the other firm influence your profit and the profit of the other firm on the market in question. [[see Table 9]]

The rows of the chart show your sales volume which can be seen in the left margin. The sales volume of the other firm is shown in the columns. The amount you expect the other firm to choose can be seen in the top row. The number in each cell of the chart shows how much you earn in this round if you choose the amount indicated by the row of this cell, and the other firm chooses the amount indicated by this column.

The profit of your partner's firm in this market can be determined with the same chart. If you want to know how much the other firm will earn, all you have to do is invert the lines and rows of the chart, i.e. in this case your sales volume can be seen in the columns, and the sales volume of your partner is shown in the rows. The intersection cell shows the earnings of your partner's firm. This may help you find out which amount the other firm might choose. However, you cannot influence the sales volume chosen by the other firm. Nevertheless, it is important for your own decision to have a precise assumption about how the other firm will act.

To help you with your considerations you can click the sales volume you expect the other firm to choose in the top row and the sales volume you want to choose yourself in the left margin. The corresponding row and column will be indicated in red. The profit you will earn in this market in this round if your partner indeed acts as you guess will be circled. You can try several combinations if you want to. Please confirm your final decision by clicking the OK button. The payoff of one market in a round depends on the sales amount chosen by you and the sales amount chosen by the other firm.

To help you to keep track there is a table at your seat to fill in your sales volume, your partner's sales volume, and your profit after each round.

The profits in the charts are given in ECU (experimental currency units). You will be informed about the exchange rate of ECU into Euro on your computer screen at the beginning of the experiment. This rate is the same for all participants. At the end of the experiment you will be paid the sum of your profits from all rounds in Euro. This amount will be paid to you privately. No other participant will learn from us how much you have earned.

Once you have read the instructions carefully, please start answering the questions on the computer screen. There will be one question at a time on the screen. These questions check your understanding of the experiment. Unfortunately, you will only be allowed to take part in the experiment if you understood the rules. If you make too many mistakes in the questionnaire, you cannot participate. If you are not sure about how to answer a question, you may read the instructions again, of course.

C. Frequencies of pairs of choices

Figures 8 and 9 displays frequencies of pairs of choices for the treatments with strategic substitutes and complements, respectively. In each graph colors and sizes of the symbols show differences between relative frequencies of choices in a treatment (for a given market type, either strategic substitutes or complements) and the average of this market type (strategic substitutes or complements). The size (area) of the symbols is proportional to the relative frequencies of choices in this treatment minus the relative frequency of choices in all treatments with markets for strategic substitutes or complements, respectively. Numbers of treatments correspond to Table 2.

Figure 8 Frequencies of pairs of choices compared to average treatment—substitutes

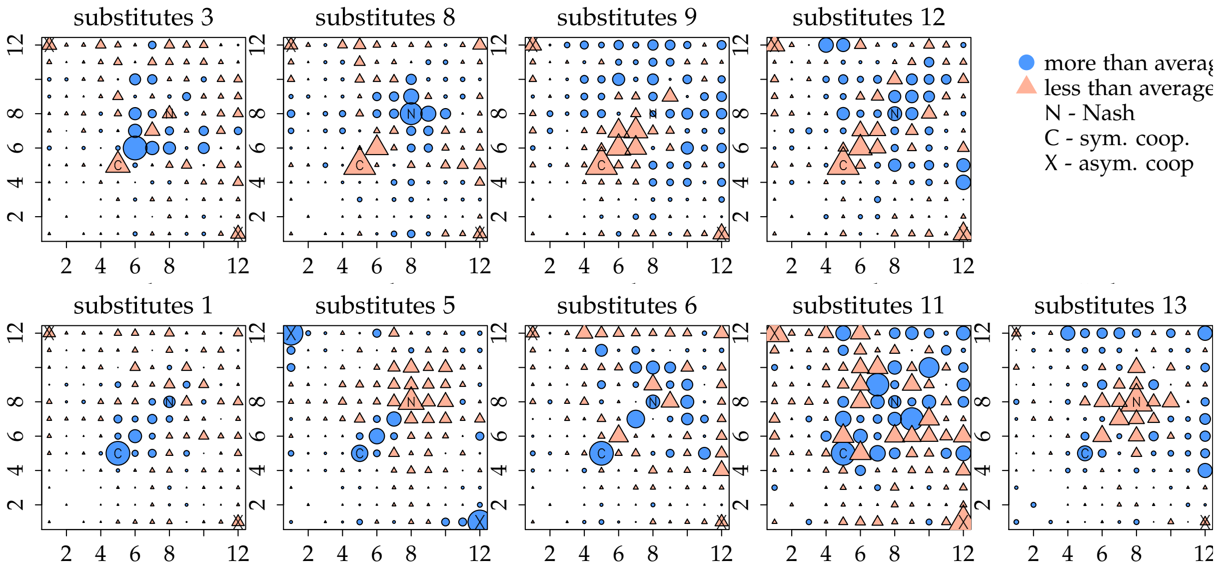


Figure 9 Frequencies of pairs of choices compared to average treatment—complements