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Quality Provision in Competitive Health Care Markets– Individuals vs. Teams

Abstract

We investigate the quality provision behavior and its implications for the occurrence of collusion in competitive health care markets where providers are assumed to be altruistic towards patients. For this, we employ a laboratory experiment with a health care market framing where subjects decide on the quality levels for one of three competing hospitals respectively. We vary whether quality decisions within hospitals are made by individuals or teams. Realized monetary patient benefits go to real patients outside the lab. We find that degrees of cooperation quickly converge towards negative values implying absence of collusion and patient centered quality choices. Moreover, hospitals treat qualities as strategic complements and adjust their quality choice in the same direction as their competitors. The response magnitude for team markets is weaker. This is driven by the non-cooperative, or altruistic teams which tend to set qualities strategically independent.

JEL-Code: C92, D03, D43, D64, I11, L13

Keywords: Quality competition; health care markets; team decisions; altruism; laboratory experiment

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1. Introduction

Economists have used laboratory experiments to study competition in markets for quite some time (see Holt, 1995 for less and Potters and Suetens 2013 for more recent examples). The majority of the experiments is either set in a quantity or price competition environment. An important distinction between games of quantity and price setting is that the former are considered as strategic substitutes and the latter as strategic complements in competition. Generally, for strategic substitutes the optimal response to an aggressive strategy by the competitor is to become less aggressive, i.e. move into the opposite direction, while for strategic complements the optimal response is to become more aggressive and follow the direction of the move (Tirole, 1988). Holt (1995) suggests that tacit collusion is more prevalent in price-setting contexts than in quantity-setting contexts. This is also what Suetens and Potters (2007) find in a meta study. Potters and Suetens (2009) investigate this phenomenon more generally in their experiments and indeed find more cooperation in games with strategic complementarities than with substitutabilities.

The optimality of a response by an agent to a rival's action is determined by the objective function she is maximizing. For games focusing on competition of profit maximizing agents, the joint profit maximizing collusive outcome and the non-cooperative competitive outcome are relevant benchmarks. However, when we relax the assumption about profit maximizing agents and instead assume that they genuinely care about their consumers, strategic interactions and collusive behavior are not straightforward anymore. This aspect is especially relevant in health care markets, where providers are assumed to be semi-altruistic, i.e. they do not only consider profits but also patient benefits to some degree in their objective functions (Ellis & McGuire, 1986, 1990; Chalkley & Malcomson, 1998; Jack, 2005; Chone & Ma, 2011; Liu & Ma, 2013). Recent laboratory experiments have identified such altruism heterogeneity in medical provision behavior for individual decisions (Godager & Wiesen, 2013; Brosig-Koch et al., 2016, 2017a). When these heterogeneously semi-altruistic providers are competing, the outcome might be different from classic market experiments with profit maximizing agents.

Another particularity of health care markets is that prices are often regulated. Then, the strategic variable is neither price nor quantity, but quality. Moreover, quality might not only be a strategic variable in a competition context but also depend on the provider's degree of altruism. While profit-maximizing agents treat quality solely as a strategic complement and respond to high quality because their competitors also provide high quality, others might be altruistic and regard the quality level as a standard they want to meet independent of competition. Extremely patient centered providers could then even perceive quality as a substitute when they feel that they have to compensate for the rivals' quality levels. Thus, a provider's objective function will affect her quality provision behavior in the market. Moreover, the composition of the providers in the market will determine their interaction.

This interaction between strategic nature and altruism is described by recent theoretical research. Brekke et al. (2017) assume that the strategic nature of quality competition crucially depends on the degree of altruism and the interaction between quality and cost-containment incentives. Without room for cost-containment, they show that qualities are strategic complements if altruism is relatively low compared to the cost-substitutability between quality and output. In contrast if altruism is relatively high, qualities can also be substitutes.

The empirical literature on the strategic nature of qualities in health care markets is rather small and not straightforward, i.e. if at all they find positive significant associations between rivals quality choices. Gravelle et al. (2014) investigate whether a hospital's quality depends on the quality of rival hospitals using data from the English National Health Service and find mixed results, i.e. only some quality indicators are positively associated and thus complements. Yet, they do not find evidence for any negative association. In a follow-up study, Longo et al. (2017) investigate a longer time horizon and only find positive significant associations for one out of eight quality indicators. Guccio and Lisi (2016) use data for Italian hospitals and investigate the strategic nature of caesarean section rates. They show that a hospital's provision behavior is strongly affected by the one of the other hospital within one region.[1]

Yet, the data from the field might be prone to certain challenges making a controlled analysis difficult. For instance, a necessary assumption for provider coordination and demand effects is that quality is perfectly observable. This is, however, not necessarily the case. While reforms including policies targeting to increase transparency by publicizing physician quality information have gained popularity (Dranove & Jin, 2010), other aspects such as multidimensionality of quality often in combination with subjective perceptions of overall

[1] Note that the literature mentioned here only focusses on qualities. Some spatial analyses consider, e.g., expenditures (Moscone, Knapp, & Tosetti, 2007a; Moscone, Tosetti, & Knapp, 2007b).

quality, as well as neglecting of quality reports at all lead to a lack of transparency in the field. This makes coordination much more difficult.

Another important aspect that may affect quality provision in hospitals is that decisions are often made by teams instead of individuals. The unitary player assumption that is common in the industrial organization literature might be less reasonable in the health care sector where the involved stakeholders put different weights on profit and patient centeredness.[2] Also, from field data it is difficult to infer, whether providers react to their competitors quality choice, or whether the quality choice is an outcome of the decision process within the hospital and potential effects of adhering to a social norm or treatment style.

The objective of this paper is to investigate how competing and semi-altruistic hospitals provide quality when decisions on the latter are either made on individual or team level. Particularly, we aim at analyzing their implications for the occurrence of collusion. For this, we implement a controlled laboratory experiment framed to describe quality competition between health care providers based on Han et al. (2017). In the experiment, participants take on the role of a decision maker in a hospital and have to choose a quality level for their respective hospitals. The market consists of three hospitals, which compete for patients by their quality choice in a repeated Salop oligopoly game. We also implement an experimental condition with team decision process. Here, hospital boards are made up of three members, which have to agree on a quality via a simple majority rule. Decisions affect real patients outside the laboratory since the generated patient utility is monetized and transferred to a charity that provides medical care to patients without access to formal health care.

Our paper contributes to the growing literature on health economic experiments on provider behavior (Hennig-Schmidt et al., 2011; Kesternich et al., 2015; Brosig-Koch et al., 2016, 2017a,b). While there is some research investigating competitive markets with semi-altruistic healthcare providers and showing that semi-altruism yields better patient outcomes than expected for profit maximizing agents (Brosig-Koch et al., 2017b; Han et al., 2017), none of them investigates the strategic nature of quality and its implications for the occurrence of collusion given the specifics of quality competition and team decisions within health care

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[2] Contributions by Pauly & Redisch (1973) and Harris (1977) address the issue of stakeholders with different objectives in hospitals while Phelps (2002) investigates different preferences in the ruling body of hospitals when it comes to quality decisions. For a detailed discussion of team decisions in hospitals see Barros and Olivella (2011).

markets.[3] Our paper also contributes to two strands of literature on market experiments. The first strand investigates tacit collusion in repeated Bertrand and Cournot markets (Potters & Suetens, 2007, 2009) showing that it is more difficult to establish collusion when strategic variables are substitutes. The second one analyzes team decisions in market games suggesting that teams are generally closer to the game theoretical predictions than individuals are (see e.g. Bornstein, 2008 and Kugler et al., 2012 for surveys).[4] However, our setting is unique because given the externalities for patients, semi-altruism is a plausible assumption in these markets and the game theoretical benchmarks with profit maximizing agents might be less relevant.

Our main results can be summarized as follows. We show that individual and team markets, start at slightly positive degrees of cooperation. However, they quickly converge towards negative values indicating patient centered behavior. While the average degrees of cooperation (quality levels) are higher (lower) for individual than for team markets, the difference is not significant. We also show that initially qualities are significantly more homogeneous in team markets than in individual ones. This might be explained by the preceding team decision process with majority voting filtering out extreme quality choices from the beginning on. Towards the final periods, both markets coordinate at levels between the competitive and patient optimal outcome. We also consider strategic quality provision behavior and find that hospitals led by an individual treat qualities as strategic complements and adjust their quality choice in the same direction as their competitors. This also holds for hospitals led by teams. However, their response magnitude is weaker. This is driven by non-cooperative, or altruistic, team markets, which do not seem to be responsive to changes in their rivals' qualities but tend to set qualities independently.

The paper proceeds a follows. Section 2 outlines the experimental design. Section 3 summarizes the predictions. In Section 4 we present the results, and in Section 5 we conclude.

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[3] Note that Brosig-Koch et al. (2016a) consider collusive behavior, but only for two physicians. Han et al. (2017) investigate the effects on quality of a merger due in health care markets with quality competition and do not investigate coordination behavior.

[4] Note that the evidence has a tendency but is to some degree ambigious. Bornstein and Gneezy (2002), e.g., find that teams converge to the competitive solution quicker, while Raab and Schipper (2009) find no differences between individual and team decisions for three firm Cournot oligopolies.

2. Experimental Design and Theoretical Framework

2.1 Experimental Design and Decision Situation

Individual Decisions

Our setting is similar to a classical market experiment but with a health care framing. Instead of firms there are hospitals competing for patients. Participants are randomly matched into a market and are in charge of quality decisions for one of three competing hospitals. At the beginning of each period, subjects simultaneously choose the quality level q that they want to provide with $q \in \{1,2,3,\dots,13\}$.[5] The quality level affects patient utility – the higher the better – which determines the patients' hospital choice and therefore market demand and hospital profits. Overall, participants play 15 periods where they decide on the quality.

Subjects are provided with full information about the possible consequences of their own and their competitor hospitals' quality decisions with respect to profits and patient benefit. A profit and patient benefit table is handed out with the instructions (see Appendix A.1 and A.2) and a calculator is implemented in the computer program where subjects can simulate different quality combinations in the market with the respective outcomes.

Patient utility is measured as the total utility derived by the unit mass of patients in the market from the quality provided by the three hospitals (More details in 2.2.). Subjects can use the implemented calculator to calculate their own contribution and the contribution by the other hospitals to it. There are no real patients in the lab. To create a more realistic decision situation that allows for altruism towards patients, we implemented a transfer of the monetary equivalent of quality choices similar to Eckel and Grossman (1996), Hennig-Schmidt et al. (2011), and Brosig-Koch et al. (2016, 20171, b).[6] Participants in the experiment knew that the higher the level of quality provided, the more money would go to a charity granting access to health care to uninsured patients in Germany who would not be treated otherwise.

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[5] Note that we implemented a discrete choice set compared to the continuous theoretical framework in order to decrease complexity for individuals.

[6] Eckel and Grossman (1996) show in a double blind scenario of a dictator game – thus independent of any experimenter demand effect – that when the money goes to a real charity this substantially increases altruistic giving compared to a scenario with student recipients.

Team Decisions

Our main ceteris paribus variation is the way decisions are made.[7] In addition to individual decisions, we have a team condition where subjects are matched in teams of three and form a hospital board that makes decisions about the hospital quality. With three subjects in each hospital board, nine players form a market. Hospital quality level q is determined by a majority vote of the hospital board members. The decision mechanism is a simple majority rule similar to Gillet et al. (2011). If at least two members propose the same quality level, it is implemented as the hospital quality level for the current period. If no majority is reached within a voting round, the same voting process is continued until a majority decision is reached. Our experimental conditions thus vary in whether decisions are made at individual or team level (see Table 1).

Table 1: Experimental Conditions Overview

Conditions	Number of subjects	Number of hospitals	Number of markets[8]
Individual	213	213	71
Team	342	114	38
Total	**555**	**327**	**109**

2.2 Theoretical Framework

The theoretical framework for the experimental design is based on Han et al. (2017), who investigate market outcomes for different degrees of competition. We consider a Salop model with an exogenously fixed number of three hospitals that compete in terms of treatment quality (Salop, 1979). In the following, we will briefly present the model framework and the hypotheses for market outcomes.

[7] For a comparison of a Monopoly and competitive market see Han et al. (2017).

[8] Note that all observations for the individual markets and for 13 team markets are taken from Han et al. (2017). We ran further sessions to get additional 25 independent observations for team markets. To be in line with Han et al. (2017), all sessions consisted of two parts, where the first part was an individual or team competition scenario, while the second part went along with a change in market concentration. In this study, we are only interested in the first part, so we can pool the observations within all individual and team conditions from Han et al. (2017).

Profit-maximizing Providers

A unit mass of patients is uniformly distributed on a circle. Patients receive medical treatment in equidistantly located hospitals. A patient's utility depends on the quality level q_i received in hospital i with $i \in \{1,2,3\}$, as well as on the travel distance between the hospital's location x_i and the patient's location z. The disutility from traveling is measured by $t > 0$. Patients are fully insured, i.e. prices for treatment do not affect their utility. Furthermore, it is assumed that the "basic" valuation of treatment v is sufficiently large to ensure that receiving treatment is always preferred to remaining untreated.[9] Given the hospital's location x_i and the patient's location z, the patient's utility u_{z,x_i} is given by:

$$u_{z,x_i} = v + q_i - t\,|z - x_i|\,. \tag{1}$$

It can be shown that hospital *i*'s demand D_i depends on the quality choices of all three hospitals active in the market and is given by:

$$D_i = \frac{1}{3} + \frac{2\,q_i - \sum_{j \neq i} q_j}{2\,t}\,. \tag{2}$$

Hospitals compete for patients in terms of quality.[10] Since prices p for treatment are exogenously given by a regulator and marginal costs c>0 per quality are constant, hospital *i*'s profit function can be written as:

$$\pi_i = (p - c\,q_i)\,D_i\,. \tag{3}$$

The three competing hospitals simultaneously choose their quality level in order to maximize their profit function as stated in Eq. (3).[11] If we take the First Order Condition (FOC), we can solve for the best-quality-response function for each hospital:

$$q_i(q_j) = \frac{1}{2}\frac{p}{c} + \frac{\sum_{j \neq i} q_j}{4} - \frac{t}{6}. \tag{4}$$

The corresponding symmetric Nash equilibrium quality q_i^* and profit level π_i^* of hospital i is given by:

$$q_i^* = \frac{p}{c} - \frac{t}{3} \quad \text{and} \quad \pi_i^* = \frac{c\,t}{9}. \tag{5}$$

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[9] The assumption of linear demand is a strong one. Changing the demand function possibly changes the prediction of the model. This is a clear limitation of the model and the corresponding experiment.

[10] In our model approach, hospitals cannot endogenously choose locations since their locations are fixed.

[11] We assume in the following that disutility from traveling is sufficiently small, i.e. $t < 3\,p/c$.

To derive theoretical benchmarks and derive hypotheses, we now introduce our experimental parametrization of the formal model. We chose our parameters in a way that they satisfy the participation constraint for patients, i.e. demanding treatment even under the hospital's minimal quality provision of 1 ($v = 5$) and that patients do not travel beyond one of their neighboring hospitals for receiving a treatment ($t = 36$). Regulated prices are set at $p = 44$ and treatment costs at $c = 2$.[12] Subjects could choose a quality level $q_i \in \{1,2,3,\dots,13\}$.

Based on this parametrization, we introduce some relevant benchmarks (see Table 2). The symmetric Nash equilibrium is reached at a joint quality level of 10 where each hospital makes a profit of 8 Taler[13] and contributes 4 Taler to the patient population. The patient optimum is at a quality level of 13 with a lower per hospital profit of 6 Taler and a higher contribution to the patient of 5 Taler. When all hospitals choose the minimum quality level of 1, the joint profit maximum (JPM) is reached. Every hospital gets a profit of 14 Taler in this period and 1 Taler goes to the patient population. The benchmark defect refers to defecting from this collusive JPM. The optimal defection choice for purely profit maximizing providers is a quality level of 5 or 6[14], both leading to profits of 15.11 Taler (a full profit and patient utility table can be found in Appendix A.1)

Following Suetens and Potters (2007) and Potters and Suetens (2009), we translate these quality benchmarks into degrees of cooperation. This gives us a straightforward indication about how collusive a health care market actually is. The degree of cooperation for health care market k in period t is calculated by:

$$\rho_{kt} = \frac{Avg.\ \ Market\, Quality_{kt} - Quality^{Nash}}{Quality^{JPM} - Quality^{Nash}}. \qquad (6)$$

Given our parametrization, it holds that $\rho_{kt} = 0$ for average quality choices at the non-cooperative Nash Equilibrium of 10. The JPM would result in $\rho_{kt} = 1$ while a uniform quality choice at the patient optimum would result in $\rho_{kt} = -0.33$.

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[12] A quality level of zero is excluded in the design as this would mean non-treatment. Treating a patient should at least lead to the lowest quality level possible.

[13] Taler is our experimental currency unit. 1 Taler = 0.07 or 0.21, depending on treatment. For more details see chapter 2.3.

[14] Due to the discrete parametrization for our experiment, the best response is ambiguous.

Hypothesis 1: For profit maximizing subjects, the Nash equilibrium predicts a symmetric quality choice of 10 that translates into a degree of cooperation of 0. Cooperative markets will have a positive degree of cooperation.

Table 2: Theoretical Benchmarks

	Quality level	Profit	Patient Utility	Degree of Cooperation
Nash Equilibrium	10	8	4	0
Patient Optimum	13	6	5	-0.33
JPM	1	14	1	1
Defect from JPM	5/6	15.11	2.67/3.19	

Notes: Profit and patient utility for *JPM, Nash equilibrium* and *patient optimum* are in symmetric scenarios where all providers choose the same level of quality. For *Defect from JPM,* profit and patient utility only applies to the defector while the other providers are still choosing a quality level of 1.

Semi-altruistic Providers

So far, our theoretical framework assumes pure profit-maximizing hospitals. However, when assuming semi-altruistic hospitals similar to Brekke et al. (2011, 2017)[15], a hospital i's objection function can be written as:

$$\Omega_i = (p - c\, q_i) \cdot D_i + \alpha \cdot B_i \tag{7}$$

where $B_i = \int_o^{\hat{z}_i^{i+1}} (v + q_i - ts) ds + \int_o^{\hat{z}_i^{-1}} (v + q_i - ts) ds$ is the total utility of the patients being treated by hospital i and $\alpha > 0$ is a measure for degree of altruism. Thus, hospitals take, to some extent, patient utility directly into account when deciding on quality.

The optimal quality decision for hospital i can be found by optimizing for q_i:

$$\frac{\partial \Omega_{\mathrm{i}}}{\partial q_i} = -c \cdot D_i + (p - c \cdot q_i) \cdot \frac{\partial D_i}{\partial q_i} + \alpha \frac{\partial B_i}{\partial q_i} = 0. \tag{8}$$

We can then derive the best response function:

$$q_i(q_j) = \frac{12\, p + 6\, c\, \sum_{j \neq i} q_j - 4\, c\, t + \alpha\left(-3\, \sum_{j \neq i} q_j + 2\, t + 12\, v\right)}{6\,(4\, c - 3\, \alpha)}. \tag{9}$$

[15] Note that we do not consider cost-containment efforts here, as this aspect is not considered in the experimental design.

The strategic relationship is given by:

$$\frac{\partial q_i(q_j)}{\partial q_j} = \frac{-\alpha + 2c}{2(4c - 3\alpha)} > 0 \Leftrightarrow \ \alpha > 2c; \alpha < \frac{4c}{3} \tag{10a}$$

$$\frac{\partial q_i(q_j)}{\partial q_j} = \frac{-\alpha + 2c}{2(4c - 3\alpha)} < 0 \Leftrightarrow \ \frac{4c}{3} < \alpha < 2c\,. \tag{10b}$$

While the best response function in Eq. 9 allows quality to be a strategic complement as well as a strategic substitute, semi-altruistic hospitals that maximize their objective functions should treat quality as strategic complement since the second order condition requires $\alpha < \frac{4c}{3}$.

The Nash equilibrium quality $q_{i\alpha}^*$ and profit level $\pi_{i\alpha}^*$ of hospital i is then given by:

$$q_{i\alpha}^* = \frac{6\,(p+\alpha\, v) - t(2\,c - \alpha)}{6\,(c - \alpha)} \quad \text{and} \quad \pi_{i\alpha}^* = \frac{c\,t}{9} - \alpha\frac{t}{12}. \tag{11}$$

If altruism levels do not offset costs and regulated prices are sufficiently high (i.e. $c > \alpha$) and it holds $c(t - 6v) < 6p$, quality levels are higher (i.e. $q_{i\alpha}^* > q_i^*$) and profits are lower compared to pure profit-maximizing hospitals (i.e. $\pi_{i\alpha}^* < \pi_i^*$). Thus, our theoretical baseline result is that higher degrees of altruism tend to increase quality levels and decrease profits. Semi-altruistic hospitals should thus provide higher quality levels and realize lower profits than pure profit-maximizing hospitals.

Given our parametrization the degree of cooperation is $\rho_{kt} = -0.33$ for uniform quality choices at the patient utility optimum of 13, see Table 2. Hence, in contrast to profit maximizing providers, for which the Nash Equilibrium predicts a symmetric quality choice of 10 that translates into a degree of cooperation of 0, markets with semi-altruistic providers should supply higher quality levels and have a negative degree of cooperation. While negative values of ρ_{kt} are interpreted as high competitiveness in Potter and Suetens (2009) beyond the Nash equilibrium, negative values in our setting also correspond to average quality choices towards the patient utility optimum.

***Hypothesis 2a*:** Higher degrees of altruism tend to increase quality levels. Semi-altruistic hospitals should thus provide higher quality levels than pure profit-maximizing hospitals. This will result in markets with a negative degree of cooperation.

***Hypothesis 2b*:** Hospitals that maximize their objective function treat quality as a strategic complement. Hospitals who do not maximize their objective function might also treat quality as a strategic substitute.

Collusion

Full collusion is established if all providers agree on the lowest quality level of 1 and JPM profits are shared between them. Given our parametrization it holds that the degree of cooperation $\rho_{kt} = 1$ for full collusion at the JPM, see Table 2. Hence, in contrast to profit maximizing hospitals, for which the Nash equilibrium predicts a symmetric quality choice of 10 that translates into a degree of cooperation of 0, collusive hospitals should provide lower quality levels and have a higher degree of cooperation.

***Hypothesis 3a*:** Collusive hospitals should provide lower quality levels than pure profit-maximizing hospitals, and will have a higher degree of cooperation.

While collusion is straightforward in a classical market experiment with firms, the implications for collusion in our experimental design are not. In the experiment, the latter will also depend on the extent to which the patient utility enters a participant's objective function and whether she maximizes the objective function or not. Regarding profits, colluding on the JPM yields a 75 percent increase in profits for providers compared to the Nash Equilibrium while defecting only leads to roughly 8 percent more profits than in JPM. In other words, the punishment by someone with a trigger strategy (playing the Nash quality level until the end as a response to defection) is financially severe compared to the defection gains. Hence, for profit maximizing providers, collusion is relatively profitable and defection rather unattractive. However, for semi-altruistic providers, who consider the patient benefit in their objective function, a stable JPM is less likely than for purely profit maximizing ones as defection gains in terms of patient utility are highest from the JPM, see patient utility table in Appendix 1 and discussion in Appendix 3. Hence, the overall defection incentives are amplified for semi-altruistic providers.

***Hypothesis 3b*:** We should observe less collusion for semi-altruistic providers than for purely profit maximizing ones.

Team Decisions

Finally, we derive expectations for team decisions based on the existing empirical evidence.[16] Comparing individual decisions with team decisions relates to the discussion about the 'unitary player assumption' and whether team behavior and individual behavior is equivalent. This might be even more important in health care markets as providers' preferences concerning profits and patient benefit might be heterogeneous in the internal decision making process.[17] While health economic experiments investigating health care provider behavior have observed heterogeneity in altruism of providers (Godager & Wiesen, 2011; Brosig-Koch et al., 2016, 2017a), little is known about team decisions with potentially heterogeneously altruistic health care providers.

There is a vast literature on group behavior in different economic experiments (See e.g. Engel, 2010 for a survey).[18] Some studies investigate group behavior in market competition experiments with homogenous goods. Bornstein et al. (2008), e.g., find that teams have a harder time to establish tacit collusion than individuals in Bertrand duopolies. Bornstein and Gneezy (2002) also find differences as teams converge to the competitive solution quicker. Raab and Schipper (2009), on the other hand, do not find differences for three firm Cournot oligopolies. In our context of quality competition between groups, we cannot be sure how altruistic motives interact with the strategic nature of quality.

Hypothesis 4**:** Given the existing literature, the effect of team decisions on the quality of care is ambiguous.

[16] An extension of the experimental model framework to teams would have been beyond the scope of this paper that focusses on the experiment.

[17] Contributions by Pauly and Redisch (1973) and Harris (1977) address the issue of stakeholders with different objectives in hospitals while Phelps (2002) investigates different preferences in the ruling body of hospitals when it comes to quality decisions. For a detailed discussion of team decisions in hospitals see Barros and Olivella (2011).

[18] Most surveys, indicate that teams are typically closer to the standard game theoretic predictions than individuals are (see e.g. Bornstein, 2008; Cooper & Kagel, 2005; Kugler, Klausel & Kocher, 2012). However, there is also a small number of studies reporting team decision to be less selfish and rational compared to individual decisions (see e.g. Kocher & Sutter, 2007; Müller & Tran, 2013).

2.3 Experimental Procedure

The experiment was programed using the software zTree (Fischbacher, 2007) and conducted at the Essen Laboratory for Experimental Economics (elfe) at the University of Duisburg-Essen, Germany in 2015. 555 students (213 in the individual conditions and 342 in team conditions) from different fields of studies using the recruiting system ORSEE (Greiner, 2015).[19]

Upon arrival, subjects were randomly assigned to seats in the laboratory and received written instructions for the first part of the experiment.[20] They were informed that the experiment consisted of two consecutive parts. But they received the instructions for the second part only after having finished the first part of the experiment. After participants read the instructions and could ask comprehension questions that were answered in private, they were asked to answer control questions. The experiment did not start unless all subjects had answered the control questions correctly. At the end of the experiment, subjects had to complete a short questionnaire with demographic and experiment related questions. On average, a session lasted 120 minutes. Monetary amounts were displayed in the Taler experimental currency, with an exchange rate of 1 Taler = 0.07€ in the individual conditions and 1 Taler = 0.21€ in the team conditions. In the team conditions, the average payoff subjects received in the experiment (for part 1) was 17.20 € (7.57€), and the average contribution to patients was 17.20€ (4.58€). In the individual conditions, the average payoff per subject was 17.75 € (7.98€), and the average contribution to the patient was 8.14 € (4.37€) respectively.[21]

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[19] Out of all participants, 286 were female and 269 were male. Furthermore, our sample include 27 medical students and 199 business and economics students.

[20] Note that individual and team treatments had different durations. Hence, sessions were held separately. Also note, that we only used the observations from the first part for this study.

[21] We applied a procedure similar to Eckel and Grossman (1996), Hennig-Schmidt et al. (2011), and Brosig-Koch et al. (2016a,b 2017) to verify this transfer. After each session, a randomly chosen subject monitored the procedure. This included checking that the correct amount was written on the transfer order to the university's financial department and depositing the order in a sealed envelope in the closest by mailbox. This effort was compensated with an additional €5.

3. Results

3.1. Degree of Cooperation

Following Suetens and Potters (2007) and Potters and Suetens (2009), we begin with analyzing cooperative behavior in our health care markets by presenting our results on collusion in terms of the degree of cooperation.

On aggregate, both individual and team markets have negative average degrees of cooperation, i.e. -0.0384 for individual and -0.1094 for team markets (see Table 3). The difference of their respective average degree of cooperation to 0, is significant for teams (Wilcoxon signed rank test (WSR), p=0.0001) and individuals (WSR, p=0.0130). This indicates that markets are to some degree patient centered. The difference in the average degrees of cooperation between individuals and teams is not significant (Man-Whitney U test[22] (MWU): p=0.1736).

Next, we consider the dynamics over the 15 periods. Figure 1 illustrates the average degrees of cooperation for both, individual and team markets, over the 15 rounds. To account for this variation over time, we separately calculate means for periods 1-5, 6-10, and 11-15 (see Table 3). The average degrees of cooperation for both types of markets start in period 1 at similar positive levels around 0.1 and quickly drop to 0 and below over the first 5 periods. The drop is higher for team conditions but the difference between treatments is not statistically significant at this stage (MWU: p=0.4803).[23] In the middle stage between periods 6 and 10, both markets establish degrees of cooperation below and significantly different from 0 (Individuals: WSR, p=0.0026; Teams: WSR: p=0.0001). Individual markets are at a level of -0.0527, while team markets are at -0.1314. Hence, team markets show lower degrees of cooperation and potentially more patient centered behavior than individual markets after markets have settled. This difference in cooperation rates between individual and team markets is not significant (MWU p=0.1367).[24] The final stage between period 11 and 15 does not differ much from the

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[22] Always two-sided unless indicated otherwise.

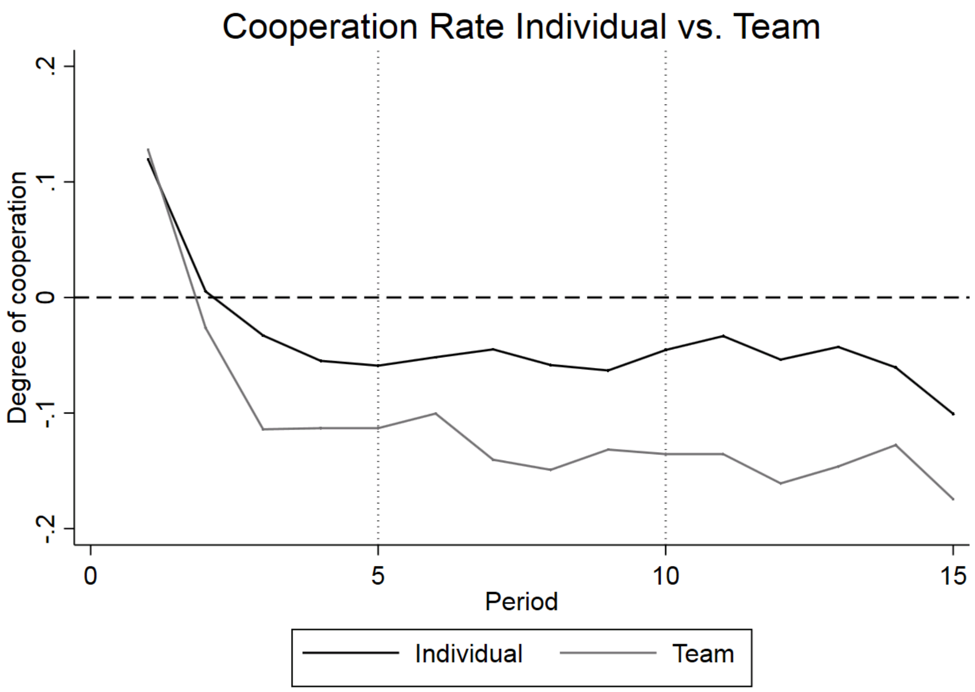
[23] Note that standard deviations are constantly higher in the individual markets than in the team markets. There seems to be a higher variety of different markets in terms of cooperation degree when individuals are in charge. We will have a closer look at this variety in Appendix 4. The lower standard deviation also suggests that the voting process in team decisions aligns the voting behavior.

[24] While we cannot reject an equality in distributions with the MWU, there are still some relevant differences between treatments. The majority of markets in both treatments have negative degrees of cooperation (69 percent of individual and 82 percent of team markets) with almost identical average levels of -0.17 for individuals and -0.18 for teams. However, among markets with positive degrees of cooperation, the average degree of cooperation

previous one. While, degrees of cooperation differ significantly from 0 (WSR: p=0.0027 in individual markets; WSR: p=0.0001 in team markets), the difference of their distribution between individual and teams does not differ significantly (MWU, p= 0.2369).[25]

Hence, while individual markets show behavior that is close to non-cooperative profit maximization, hospitals in team markets tend to choose quality levels that are more patient centered. If we translate the degrees of cooperation of the final stage (period 11 to 15) into quality choices, the average quality level is at 10.52 (s.d. 2.327) for individual markets and 11.34 (s.d. 1.020) for team markets. Thus, markets in both conditions have average qualities higher than the Nash equilibrium level. The difference between treatments is also not significant. (MWU, p=0.2418).

Figure 1: Average Degrees of Cooperation Individual vs. Team Part 1 by Period



for individuals is much higher at 0.21 compared to teams with 0.07. In other words, uncooperative markets are very similar between treatments but cooperative markets are much more cooperative in the individual treatments – but there are not too many. So, if we would focus on the means and take a two-sided t-test, we would reject the hypothesis of equality of means with p=0.0490. This will also be addressed in Appendix 4 when we look at cooperative markets and collusion.

[25] Again, taking means into account changes the test results slightly (two sided t-test, p=0.0422).

Table 3: Average Degrees of Cooperation

	Periods					
	1	1-5	6-10	11-15	15	Total
Individual	0.1195	-0.0044	-0.0527	-0.0582	-0.1007	-0.0384
sd	0.2463	0.2184	0.2266	0.2586	0.2515	0.2353
N	71	71	71	71	71	
Team	0.1277	-0.0478	-0.1314	-0.1489	-0.1745	-0.1094
sd	0.1311	0.0962	0.1211	0.1133	0.1311	0.1183
N	38	38	38	38	38	

Result 1**:** Individual and team markets, start at slightly positive degrees of cooperation. Yet, they quickly converge to average levels significantly below 0 indicating patient centered behavior. While the average degrees of cooperation (quality levels) are higher (lower) for individual than for team markets, the difference is not significant.

3.2. Coordination Behavior

So far, we have considered the aggregate degree of cooperation. However, the latter does not shed light on within market heterogeneity and thus whether markets coordinate on certain quality levels. To get a better understanding of coordination behavior within markets, we now consider the difference between hospitals' quality choices within each market. For this, we take the absolute difference between the highest and lowest hospital quality of a respective hospital within each market in every period.[26] A small quality spread hence suggests that hospitals within a market jointly gravitate towards a reference quality level and indicates coordination behavior. Moreover, our experimental parametrization yields stronger deviation incentives from cooperative situations for treating quality as a strategic substitutes, and thus non-objective function maximizing behavior, than for complements. Hence, the quality spread might be larger in case hospitals consider quality as a strategic substitute. For reference, a profit maximizing deviation from JPM would imply a spread of 4 or 5 and moving from Nash Equilibrium to the patient optimum would imply a spread of 3 (cf. Table 2).

[26] Potters and Suetens (2009) conduct a comparable analysis, looking at within pair variability for markets with 2 participants.

Table 4: Average Quality Spreads Individual vs. Team by Period Intervals

	Periods					
	1	1-5	6-10	11-15	15	Total
Individual	4.7183	3.0169	2.4028	2.0958	1.9859	2.5052
s.d.	2.6300	1.2881	1.4613	1.3253	1.9383	1.4072
N	71	71	71	71	71	
Team	3.3947	2.2948	2.3421	1.9789	1.5526	2.2053
s.d.	2.0865	0.8646	1.1863	0.9262	0.9781	1.0063
N	38	38	38	38	38	

The average quality spreads in our experimental treatments can be inferred from Figure 2 and Table 4. We can see that the quality spread is significantly higher for individual decision makers in the first 5 periods with 3.02 quality units on average compared to 2.30 in teams (MWU p=0.0031 for period 0 to 5). Over time the spreads converge to similar levels around 2 and are not significantly different anymore (MWU: p=0.8885 for period 5 to 10; MWU: p=0.9568 for period 10 to 15). It seems that the team decision process `filters out' extreme decisions in the beginning and creates more stable market qualities overall. The dashed line in Figure 2 marks the spread of quality proposals in the majority decision process for the team decisions. As expected, its trend is parallel to the actual team decision.

While markets tend to gravitate to quality levels, these quality levels could be different for each market. Figure 3 explores the heterogeneity of resulting average market qualities in periods 11 to 14. Due to end-game effects period 15 is neglected. The left skewness of the distribution suggests that markets coordinate on levels between the competitive and patient optimal outcome towards the final periods.

Result 2**:** Initially, qualities are more homogeneous in team markets, i.e. the quality spread is significantly higher for individual than for team markets. This might be explained by the preceding team decision process with majority voting filtering out extreme quality choices from the beginning. Towards the final periods, both markets coordinate at levels between the competitive and patient optimal outcome.

Figure 2: Quality Spread in Individual and Team Markets

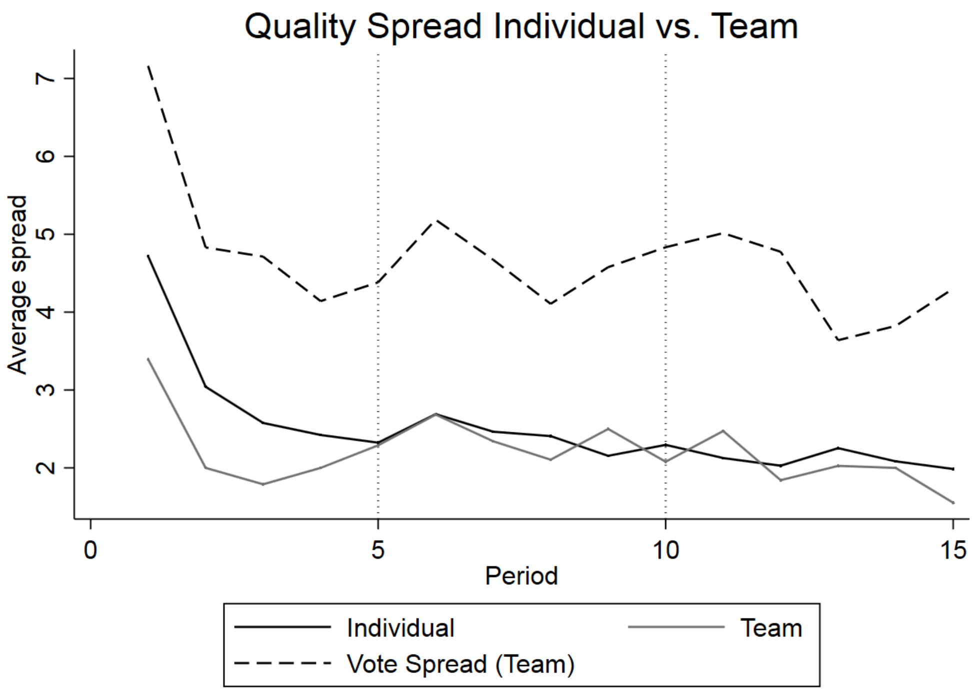
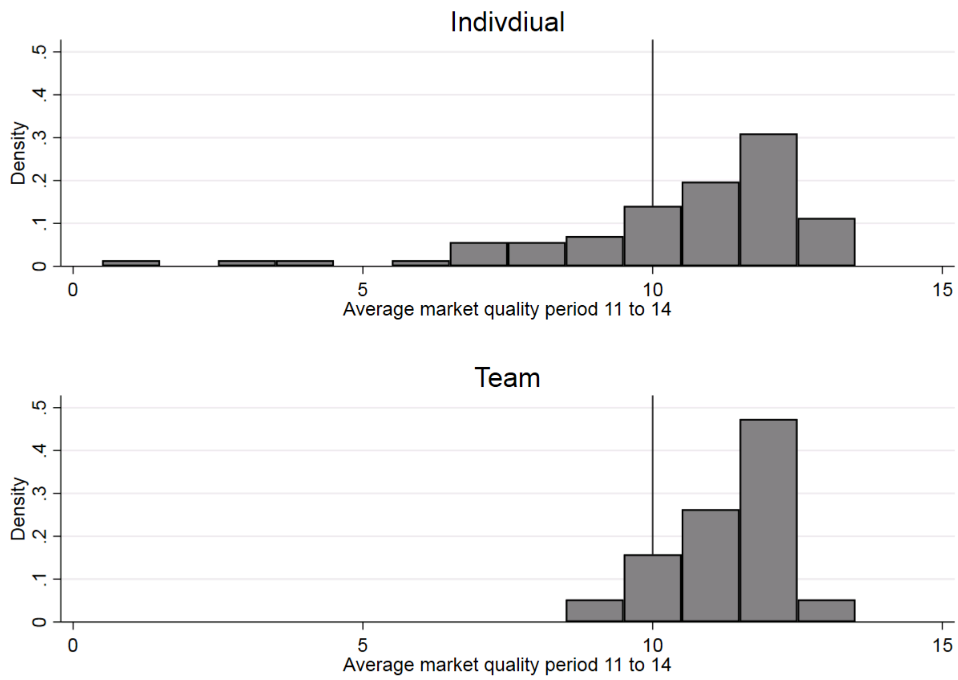


Figure 3: Average Market Quality Between Periods 11 and 14



3.3. Strategic Nature of Quality

Having identified some degree of patient centeredness, especially for team markets, we now investigate in which direction hospitals react to their competitors' average quality choice. For this, we run the following regression separately for individual and team markets:

$$\Delta choice_{it} = \beta_o + \beta_1 \Delta avg.rivalchoice_{t-1} + \nu_i + u_{it}. \tag{12}$$

The model investigates how strong and in which direction a hospital i in period t reacts to the average quality change from rivals in the previous period. On the left hand side, we have the difference in quality choice of hospital i between the previous period $t-1$ and the current period t. The independent variable is the difference in the average quality choice from period $t-2$ to $t-1$ by the competing hospitals. We include individual fixed effects. The results are presented in Table 5. In column (1) we see the results for individual markets and in column (2) for team markets. From column (1) we can infer that in individual markets the coefficient is positive and statistically significant at the 1 percent level. Hence, as predicted by our model quality choices are treated as strategic complements. This implies that hospitals maximizing their objective function play reciprocally by following the previous market quality levels. From column (2) we can see that the coefficient is still positive but smaller and significant at the 5 percent level. Hence, the effect is weaker in the team treatments, but still in line with complementarity.

Next, we separate markets by their average degree of cooperation, i.e. cooperative markets with an average degree of cooperation $\bar{\rho} > 0$ and those with an average degree of cooperation $\bar{\rho} \leq 0$. This might give us a clearer insight into the relationship between cooperativeness and strategic complementarity. From the Columns (3) and (4) compare individual and team markets in markets with a positive degree of cooperation. For both the coefficient is positive and statistically significant at the 1 percent level. Hence, one can infer that both individual and team cooperative markets display a strong strategic complementarity. Columns (5) and (6) consider non-cooperative individual and team markets with an average degree of cooperation $\bar{\rho} \leq 0$. Here, we can infer that while the coefficient for non-cooperative individual markets is still highly significant, the one for non-cooperative team markets is not significantly different from 0. Thus, teams in more patient centered markets do not seem to be responsive to changes in their rivals' qualities but tend to set qualities independently.

Table 5: Regression Results on Changes in Choices for All, Cooperative, and Non-cooperative Markets

	(1) Individual	(2) Team	(3) Individual Cooperative	(4) Team Cooperative	(5) Individual Non-Cooperative	(6) Team Non-Cooperative
Avg. rivalchange	0.268***	0.0954*	0.295***	0.492***	0.248***	0.0559
	(0.0276)	(0.0371)	(0.0485)	(0.125)	(0.0334)	(0.0387)
constant	0.0400	0.0857	0.0220	-0.00599	0.0516	0.102
	(0.0347)	(0.0514)	(0.0674)	(0.160)	(0.0396)	(0.0541)
N	2769	1482	936	156	1833	1326
R2	0.036	0.005	0.041	0.097	0.032	0.002

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Result 3: Individual hospital markets treat qualities as strategic complements and adjust their quality choice in the same direction as their competitors. This also holds for team markets. However, their response magnitude is weaker. This is be driven by non-cooperative, or semi-altruistic, team markets that are not responsive to changes in their rivals' qualities but tend to set qualities independently.

4. Conclusion

In this paper, we investigated quality competition in health care markets where providers are assumed to be altruistic towards patients with a focus on two aspects that are especially interesting from a behavioral perspective in this context: First, how hospitals react to a change in their competitors quality choice. Second, how the decision process for quality choices, i.e. individual or team decision making within hospitals, affects quality provision behavior. We implemented a laboratory experiment based on a Salop model, where hospitals competed for patients via quality provision in a market with regulated prices following Han et al. (2017). The market consisted of three hospitals. We also implemented an experimental condition with a team decision process. Here, hospital boards were made up of three members, which had to agree on a quality level via a simple majority rule. Decisions affect real patients outside the laboratory since the generated patient utility is monetized and transferred to a charity that provides medical care to patients without access to formal health care.

With respect to the general competition analysis, we find only little evidence for collusion within competitive health care markets. Particularly, we show that individual and team markets, start at slightly positive degrees of cooperation, but then quickly converge towards negative values indicating patient centered behavior. This is in line with evidence from previous health economic experiments for duopolies of general practitioners by Brosig-Koch et al. (2017b). They show that collusion, while being observed, is less frequent than in related price competition experiments without a health framing.

Comparing individual markets with team markets, we show that while the average degrees of cooperation (quality levels) are higher (lower) for individual than for team markets, the difference is statistically not significant. We also show that initially qualities are significantly more homogeneous in team markets than in individual ones. This might be explained by the preceding team decision process with majority voting filtering out extreme quality choices from the beginning on. This is in line with evidence for team markets and price competition by Bornstein and Gneezy (2002), who show that team markets stabilize much quicker than individual markets. Also, Bornstein et al (2008) find that team markets tend to behave more stable overall. Towards the final periods, we however show that both types of markets coordinate at levels between the competitive and patient optimal outcome. Potters and Suetens (2009) find similar endgame effects with negative degrees of cooperation for strategic substitutes and degrees close to the competitive benchmark for complements in the final period.

We also consider strategic behavior and find that hospitals led by an individual treat qualities as strategic complements and adjust their quality choice in the same direction as their competitors. This also holds for hospitals led by teams. However, their response magnitude is weaker. This is be driven by non-cooperative, or altruistic, team markets, which do not seem to be responsive to changes in their rivals' qualities but tend to set qualities independently. This result is in line with previous evidence by Potters and Suetens (2009) for non-collusive markets in games with strategic substitutes.[27] It reinforces the idea that cooperation is easier when goods are seen as strategic complements as Holt (1995) and Suetens and Potters (2007) suggest. This finding can also be linked to the theoretical considerations for competitive health care markets with altruistic providers by Brekke et al. (2017). They argue that qualities are strategic complements as long as altruism is relatively low compared to the cost substitutability between

[27] While the games in Potters and Suetens (2009) are designed to be either complements or substitutes, they do not observe behavior in line with strategic substitutability on average in either of the games as subjects follow their competitor's moves in both settings. The effect, however, is stronger in games with complements. They also find that non-collusive pairs in games with strategic substitutes have a response close to 0 which is in line with our findings for non-cooperative team markets.

quality and output, while strong altruism could yield qualities to be strategic substitutes. However, we do not find such extreme results except for our most altruistic markets, i.e. non-cooperative team markets. Here, qualities are no longer treated as complements but are strategically independent. We thereby also contribute to the recent field studies investigating the strategic nature of quality within hospital markets. In line with our results, they find either no response to rivals' quality in hospital settings or some evidence for complementarity for few selected quality indicators (Gravelle et al., 2014; Longo et al., 2017). Given our experimental results this might be driven by the degree of cooperativeness, or altruism of hospitals within the market.

Overall, we contribute novel experimental evidence to competition in health care markets. Our findings suggest that quality spillovers between health care providers might crucially depend on the degree of altruism and the organizational structure, i.e. whether quality decisions of the hospital are made by individuals or by teams. The previous empirical findings from the field already suggested that the quality indicator in question itself matters to analyze responsiveness and spillovers. These combined insights could be relevant for policy interventions that incentivize quality improvements. Depending on which quality indicator regulators want to target, it might be advisable to look at the quality indicator itself and the decision structure within the hospital that influences this indicator. Whether an intervention on hospital level with prospective spillovers or a centralized top down policy is more promising might hinge on these determinants.

Literature

Barros, P.P., Olivella, P. (2011). Hospitals: Teaming up!. In Glied, S. and Smith, P.C. (Eds.) The Oxford Handbook of Health Economics (432-462). Oxford: Oxford University Press.

Bornstein, G., & Gneezy, U. (2002). Price competition between teams. Experimental Economics, 5(1), 29-38.

Bornstein, G., Kugler, T., Budescu, D. V., Selten, R. (2008). Repeated price competition between individuals and between teams. *Journal of Economic Behavior & Organization*, *66(3-4)*, 808-821.

Brekke, K. R., Siciliani, L., & Straume, O. R. (2011). Hospital competition and quality with regulated prices. *Scandinavian Journal of Economics*, 113(2), 444-469.

Brekke, K. R., Siciliani, L., & Straume, O. R. (2017). Hospital mergers with regulated prices. *Scandinavian Journal of Economics*, 119(3), 597-627.

Brosig-Koch, J., Hennig-Schmidt, H., Kairies-Schwarz, N., & Wiesen, D. (2016). Using artefactual field and lab experiments to investigate how fee-for-service and capitation affect medical service provision. *Journal of Economic Behavior & Organization*, *131*, 17-23.

Brosig-Koch, J., Hennig-Schmidt, H., Kairies-Schwarz, N., & Wiesen, D. (2017a). The effects of introducing mixed payment systems for physicians: Experimental evidence. *Health Economics*, *26*, 243–262.

Brosig-Koch, J., Hehenkamp, B., & Kokot, J. (2017b). The effects of competition on medical service provision. *Health Economics*, 26, 6-20.

Chalkley, M., & Malcomson, J. M. (1998). Contracting for health services when patient demand does not reflect quality. *Journal of Health Economics*, *17(1),* 1-19.

Chone, P., & Ma, C. A. (2011). Optimal health care contract under physician agency. *Annales*

Cooper, D. J., & Kagel, J. H. (2005). Are two heads better than one? Team versus individual play in signaling games. *American Economic Review*, 95(3), 477-509.

Dranove, D., & Zhe Jin, G. (2010). Quality Disclosure and Certification: Theory and Practice, *Journal of Economic Literature*, 48(4), 935–63.

Eckel, C. C., Grossman, P. J. (1996). Altruism in anonymous dictator games. *Games and Economic Behavior, 16(2)*, 181-191.

Ellis, R. P., & McGuire, T. G. (1986). Provider behavior under prospective reimbursement: Cost sharing and supply. *Journal of Health Economics*, *5*(2), 129-151.

Ellis, R. P., & McGuire, T. G. (1990). Optimal payment systems for health services. *Journal of Health Economics*, *9(4)*, 375-396.

Engel, C. (2010). The behaviour of corporate actors: How much can we learn from the experimental literature?. *Journal of Institutional Economics*, *6(4)*, 445-475.

Fischbacher, U. (2007). z-tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics, 10(2)*, 171-178.

Gillet, J., Schram, A., Sonnemans, J. (2011). Cartel formation and pricing: The effect of managerial decision-making rules. *International Journal of Industrial Organization*, *29(1)*, 126-133.

Godager, G., & Wiesen, D. (2013). Profit or patients' health benefit? Exploring the heterogeneity in physician altruism. *Journal of Health Economics*, *32*(6), 1105-1116.

Gravelle, H., Santos, R., & Siciliani, L. (2014). Does a hospital's quality depend on the quality of other hospitals? A spatial econometrics approach. *Regional science and urban economics*, 49, 203-216.

Greiner, B. (2015). Subject pool recruitment procedures: organizing experiments with ORSEE. *Journal of the Economic Science Association*, *1*(1), 114-125.

Guccio, C., & Lisi, D. (2016). Thus do all. Social interactions in inappropriate behavior for childbirth services in a highly decentralized healthcare system. *Regional Science and Urban Economics,* 61, 1-17.

Han J., Kairies-Schwarz N., Vomhof M. (2017). Quality competition and hospital mergers - An experiment*. Health Economics*, *26*, 36-51.

Harris, J. E. (1977). The internal organization of hospitals: some economic implications. *The Bell Journal of Economics*, 467-482.

Hennig-Schmidt, H., Selten, R., Wiesen, D. (2011). How payment systems affect physicians' provision behavior - an experimental investigation. *Journal of Health Economics, 30(4)*, 637-646.

Holt, C. A. (1995). Industrial organization: A survey of laboratory research. The Handbook of Experimental Economics, 349, 402-03.

Jack, W. (2005). Purchasing health care services from providers with unknown altruism. *Journal of Health Economics*, *24*(1), 73-93.

Kesternich, I., Schumacher, H., & Winter, J. (2015). Professional norms and physician behavior: homo oeconomicus or homo hippocraticus? *Journal of Public Economics*, *131*, 1-11.

Kocher, M. G., & Sutter, M. (2007). Individual versus group behavior and the role of the decision making procedure in gift-exchange experiments. *Empirica*, *34(1)*, 63-88.

Kugler, T., Kausel, E. E., & Kocher, M. G. (2012). Are groups more rational than individuals? A review of interactive decision making in groups. *Wiley Interdisciplinary Reviews: Cognitive Science*, 3(4), 471-482.

Liu, T., & Ma, C. A. (2013). Health insurance, treatment plan, and delegation to altruistic physician. *Journal of Economic Behavior & Organization*, 85, 79-96.

Longo, F., Siciliani, L., Gravelle, H., & Santos, R. (2017). Do hospitals respond to rivals' quality and efficiency? A spatial panel econometric analysis. Health economics, 26, 38-62.

Moscone, F., Knapp, M., & Tosetti, E. (2007a). Mental health expenditure in England: a spatial panel approach. *Journal of Health Economics*, 26(4), 842-864.

Moscone, F., Tosetti, E., & Knapp, M. (2007). SUR model with spatial effects: an application to mental health expenditure. *Health Economics*, 16(12), 1403-1408.

Motta, M. (2004). Competition policy: theory and practice. Cambridge University Press.

Müller, W., Tan, F. (2013). Who acts more like a game theorist? Group and individual play in a sequential market game and the effect of the time horizon. *Games and Economic Behavior*, 82, 658-674.

Pauly, M. V., & Redisch, M. (1973). The not-for-profit hospital as a physicians' cooperative. *American Economic Review*, *63(1)*, 87-99.

Potters, J., & Suetens, S. (2009). Cooperation in experimental games of strategic complements and substitutes. *The Review of Economic Studies*, 76(3), 1125-1147.

Potters, J., & Suetens, S. (2013). Oligopoly experiments in the current millennium. Journal of Economic Surveys, 27(3), 439-460.

Raab, P., Schipper, B. C. (2009). Cournot competition between teams: An experimental study. *Journal of Economic Behavior & Organization*, *72(2)*, 691-702.

Salop, S. (1979). Monopolistic Competition with Outside Goods. The Bell Journal of Economics, 10(1), 141-156.

Suetens, S., & Potters, J. (2007). Bertrand colludes more than Cournot. *Experimental Economics*, 10(1), 71-77.

Sutter, M. (2009). Individual behavior and group membership: Comment. *American Economic*

Review, *99(5)*, 2247-2257.

Tirole, J. (1988). The theory of industrial organization. MIT press.

Appendix

A.1 Profit tables and patient utility tables

Profit table

quality level of the other two hospitals own quality level	1|1	2|2	3|3	4|4	5|5	6|6	7|7	8|8	9|9	10|10	11|11	12|12	13|13
1	**14.00** 14.00 14.00	**12.83** 13.89 13.89	**11.67** 13.72 13.72	**10.50** 13.50 13.50	**9.33** 13.22 13.22	**8.17** 12.89 12.89	**7.00** 12.50 12.50	**5.83** 12.06 12.06	**4.67** 11.56 11.56	**3.50** 11.00 11.00	**2.33** 10.39 10.39	**1.17** 9.72 9.72	**0.00** 9.00 9.00
2	**14.44** 13.42 13.42	**13.33** 13.33 13.33	**12.22** 13.19 13.19	**11.11** 13.00 13.00	**10.00** 12.75 12.75	**8.89** 12.44 12.44	**7.78** 12.08 12.08	**6.67** 11.67 11.67	**5.56** 11.19 11.19	**4.44** 10.67 10.67	**3.33** 10.08 10.08	**2.22** 9.44 9.44	**1.11** 8.75 8.75
3	**14.78** 12.83 12.83	**13.72** 12.78 12.78	**12.67** 12.67 12.67	**11.61** 12.50 12.50	**10.56** 12.28 12.28	**9.50** 12.00 12.00	**8.44** 11.67 11.67	**7.39** 11.28 11.28	**6.33** 10.83 10.83	**5.28** 10.33 10.33	**4.22** 9.78 9.78	**3.17** 9.17 9.17	**2.11** 8.50 8.50
4	**15.00** 12.25 12.25	**14.00** 12.22 12.22	**13.00** 12.14 12.14	**12.00** 12.00 12.00	**11.00** 11.81 11.81	**10.00** 11.56 11.56	**9.00** 11.25 11.25	**8.00** 10.89 10.89	**7.00** 10.47 10.47	**6.00** 10.00 10.00	**5.00** 9.47 9.47	**4.00** 8.89 8.89	**3.00** 8.25 8.25
5	**15.11** 11.67 11.67	**14.17** 11.67 11.67	**13.22** 11.61 11.61	**12.28** 11.50 11.50	**11.33** 11.33 11.33	**10.39** 11.11 11.11	**9.44** 10.83 10.83	**8.50** 10.50 10.50	**7.56** 10.11 10.11	**6.61** 9.67 9.67	**5.67** 9.17 9.17	**4.72** 8.61 8.61	**3.78** 8.00 8.00
6	**15.11** 11.08 11.08	**14.22** 11.11 11.11	**13.33** 11.08 11.08	**12.44** 11.00 11.00	**11.56** 10.86 10.86	**10.67** 10.67 10.67	**9.78** 10.42 10.42	**8.89** 10.11 10.11	**8.00** 9.75 9.75	**7.11** 9.33 9.33	**6.22** 8.86 8.86	**5.33** 8.33 8.33	**4.44** 7.75 7.75
7	**15.00** 10.50 10.50	**14.17** 10.56 10.56	**13.33** 10.56 10.56	**12.50** 10.50 10.50	**11.67** 10.39 10.39	**10.83** 10.22 10.22	**10.00** 10.00 10.00	**9.17** 9.72 9.72	**8.33** 9.39 9.39	**7.50** 9.00 9.00	**6.67** 8.56 8.56	**5.83** 8.06 8.06	**5.00** 7.50 7.50
8	**14.78** 9.92 9.92	**14.00** 10.00 10.00	**13.22** 10.03 10.03	**12.44** 10.00 10.00	**11.67** 9.92 9.92	**10.89** 9.78 9.78	**10.11** 9.58 9.58	**9.33** 9.33 9.33	**8.56** 9.03 9.03	**7.78** 8.67 8.67	**7.00** 8.25 8.25	**6.22** 7.78 7.78	**5.44** 7.25 7.25
9	**14.44** 9.33 9.33	**13.72** 9.44 9.44	**13.00** 9.50 9.50	**12.28** 9.50 9.50	**11.56** 9.44 9.44	**10.83** 9.33 9.33	**10.11** 9.17 9.17	**9.39** 8.94 8.94	**8.67** 8.67 8.67	**7.94** 8.33 8.33	**7.22** 7.94 7.94	**6.50** 7.50 7.50	**5.78** 7.00 7.00
10	**14.00** 8.75 8.75	**13.33** 8.89 8.89	**12.67** 8.97 8.97	**12.00** 9.00 9.00	**11.33** 8.97 8.97	**10.67** 8.89 8.89	**10.00** 8.75 8.75	**9.33** 8.56 8.56	**8.67** 8.31 8.31	**8.00** 8.00 8.00	**7.33** 7.64 7.64	**6.67** 7.22 7.22	**6.00** 6.75 6.75
11	**13.44** 8.17 8.17	**12.83** 8.33 8.33	**12.22** 8.44 8.44	**11.61** 8.50 8.50	**11.00** 8.50 8.50	**10.39** 8.44 8.44	**9.78** 8.33 8.33	**9.17** 8.17 8.17	**8.56** 7.94 7.94	**7.94** 7.67 7.67	**7.33** 7.33 7.33	**6.72** 6.94 6.94	**6.11** 6.50 6.50
12	**12.78** 7.58 7.58	**12.22** 7.78 7.78	**11.67** 7.92 7.92	**11.11** 8.00 8.00	**10.56** 8.03 8.03	**10.00** 8.00 8.00	**9.44** 7.92 7.92	**8.89** 7.78 7.78	**8.33** 7.58 7.58	**7.78** 7.33 7.33	**7.22** 7.03 7.03	**6.67** 6.67 6.67	**6.11** 6.25 6.25
13	**12.00** 7.00 7.00	**11.50** 7.22 7.22	**11.00** 7.39 7.39	**10.50** 7.50 7.50	**10.00** 7.56 7.56	**9.50** 7.56 7.56	**9.00** 7.50 7.50	**8.50** 7.39 7.39	**8.00** 7.22 7.22	**7.50** 7.00 7.00	**7.00** 6.72 6.72	**6.50** 6.39 6.39	**6.00** 6.00 6.00

Patient utlity table

quality level of the other two hospitals own quality level	1|1	2|2	3|3	4|4	5|5	6|6	7|7	8|8	9|9	10|10	11|11	12|12	13|13
1	**1.00** 1.00 1.00	**0.99** 1.34 1.34	**0.97** 1.71 1.71	**0.94** 2.09 2.09	**0.89** 2.50 2.50	**0.83** 2.93 2.93	**0.75** 3.38 3.38	**0.66** 3.84 3.84	**0.56** 4.33 4.33	**0.44** 4.84 4.84	**0.31** 5.38 5.38	**0.16** 5.93 5.93	**0.00** 6.50 6.50
2	**1.35** 1.00 1.00	**1.33** 1.33 1.33	**1.30** 1.69 1.69	**1.25** 2.07 2.07	**1.19** 2.47 2.47	**1.11** 2.89 2.89	**1.02** 3.33 3.33	**0.92** 3.79 3.79	**0.80** 4.27 4.27	**0.67** 4.78 4.78	**0.52** 5.30 5.30	**0.36** 5.85 5.85	**0.19** 6.41 6.41
3	**1.75** 0.99 0.99	**1.72** 1.32 1.32	**1.67** 1.67 1.67	**1.60** 2.04 2.04	**1.53** 2.43 2.43	**1.44** 2.84 2.84	**1.33** 3.28 3.28	**1.22** 3.73 3.73	**1.08** 4.21 4.21	**0.94** 4.70 4.70	**0.78** 5.22 5.22	**0.60** 5.76 5.76	**0.42** 6.32 6.32
4	**2.19** 0.97 0.97	**2.14** 1.29 1.29	**2.08** 1.64 1.64	**2.00** 2.00 2.00	**1.91** 2.39 2.39	**1.81** 2.79 2.79	**1.69** 3.22 3.22	**1.56** 3.67 3.67	**1.41** 4.14 4.14	**1.25** 4.63 4.63	**1.08** 5.14 5.14	**0.89** 5.67 5.67	**0.69** 6.22 6.22
5	**2.67** 0.94 0.94	**2.60** 1.26 1.26	**2.53** 1.60 1.60	**2.44** 1.95 1.95	**2.33** 2.33 2.33	**2.22** 2.73 2.73	**2.08** 3.15 3.15	**1.94** 3.59 3.59	**1.78** 4.06 4.06	**1.60** 4.54 4.54	**1.42** 5.04 5.04	**1.22** 5.57 5.57	**1.00** 6.11 6.11
6	**3.19** 0.91 0.91	**3.11** 1.22 1.22	**3.02** 1.55 1.55	**2.92** 1.90 1.90	**2.80** 2.27 2.27	**2.67** 2.67 2.67	**2.52** 3.08 3.08	**2.36** 3.51 3.51	**2.19** 3.97 3.97	**2.00** 4.44 4.44	**1.80** 4.94 4.94	**1.58** 5.46 5.46	**1.35** 6.00 6.00
7	**3.75** 0.88 0.88	**3.66** 1.18 1.18	**3.56** 1.50 1.50	**3.44** 1.84 1.84	**3.31** 2.21 2.21	**3.16** 2.59 2.59	**3.00** 3.00 3.00	**2.83** 3.43 3.43	**2.64** 3.88 3.88	**2.44** 4.34 4.34	**2.22** 4.83 4.83	**1.99** 5.34 5.34	**1.75** 5.88 5.88
8	**4.35** 0.83 0.83	**4.25** 1.13 1.13	**4.13** 1.44 1.44	**4.00** 1.78 1.78	**3.85** 2.14 2.14	**3.69** 2.51 2.51	**3.52** 2.91 2.91	**3.33** 3.33 3.33	**3.13** 3.77 3.77	**2.92** 4.24 4.24	**2.69** 4.72 4.72	**2.44** 5.22 5.22	**2.19** 5.75 5.75
9	**5.00** 0.78 0.78	**4.88** 1.07 1.07	**4.75** 1.38 1.38	**4.60** 1.70 1.70	**4.44** 2.06 2.06	**4.27** 2.43 2.43	**4.08** 2.82 2.82	**3.88** 3.23 3.23	**3.67** 3.67 3.67	**3.44** 4.12 4.12	**3.19** 4.60 4.60	**2.94** 5.09 5.09	**2.67** 5.61 5.61
10	**5.69** 0.72 0.72	**5.56** 1.00 1.00	**5.41** 1.30 1.30	**5.25** 1.63 1.63	**5.08** 1.97 1.97	**4.89** 2.33 2.33	**4.69** 2.72 2.72	**4.47** 3.13 3.13	**4.24** 3.55 3.55	**4.00** 4.00 4.00	**3.74** 4.47 4.47	**3.47** 4.96 4.96	**3.19** 5.47 5.47
11	**6.42** 0.65 0.65	**6.27** 0.93 0.93	**6.11** 1.22 1.22	**5.94** 1.54 1.54	**5.75** 1.88 1.88	**5.55** 2.23 2.23	**5.33** 2.61 2.61	**5.10** 3.01 3.01	**4.86** 3.43 3.43	**4.60** 3.87 3.87	**4.33** 4.33 4.33	**4.05** 4.82 4.82	**3.75** 5.32 5.32
12	**7.19** 0.58 0.58	**7.03** 0.85 0.85	**6.85** 1.14 1.14	**6.67** 1.44 1.44	**6.47** 1.77 1.77	**6.25** 2.13 2.13	**6.02** 2.50 2.50	**5.78** 2.89 2.89	**5.52** 3.30 3.30	**5.25** 3.74 3.74	**4.97** 4.19 4.19	**4.67** 4.67 4.67	**4.35** 5.16 5.16
13	**8.00** 0.50 0.50	**7.83** 0.76 0.76	**7.64** 1.04 1.04	**7.44** 1.34 1.34	**7.22** 1.67 1.67	**6.99** 2.01 2.01	**6.75** 2.38 2.38	**6.49** 2.76 2.76	**6.22** 3.17 3.17	**5.94** 3.59 3.59	**5.64** 4.04 4.04	**5.33** 4.51 4.51	**5.00** 5.00 5.00

A.2 Instructions

General Instructions for all of the Participants

The original experiment consisted of two parts, where part 2 differed between treatments. We only use part 1 for this study. Part 1 was identical for all experimental conditions. Parts of the instructions that were exclusive to the *team treatment*, are written in *italics.* Parts that were exclusive to the **individual treatment** are marked [**bold and in squared brackets**.] Everything else is identical.

Preliminary remarks

You are participating in a study of choice behavior for the purpose of experimental economic research. During the experiment you and the other participants are asked to make decisions. In doing so, you can earn money. The resulting amount depends on your decisions and the decisions of the other participants. After finishing the experiment, your total earnings will be converted into Euro and paid out to you in cash. For this experiment all amounts are designated in Taler, the laboratory currency, where 1 Taler translates to *0.21* **[0.07]** Euro.

The experiment will last approximately 150 minutes and consists of two parts. Prior to each of the two parts, you will receive detailed instructions. Note, that neither your decisions made in the first part nor the decisions made in the second part will have an influence on the respective other part. Moreover, there are neither right nor wrong answers in any of the two parts.

Part 1

Please read the following instructions carefully. In case you have any questions along the course of the experiment, please feel free to call attention for yourself by raising your hand. We will come to you to answer the open questions.

Situation: A hospital market

In this experiment, *you are part of a hospital board with three members and jointly* **[you are in charge of a hospital and]** decide on the quality level of your hospital for the treatment of patients. Apart from you, two other hospitals, *which are also led by hospital boards with three members in charge of quality decisions,* operate in the same market. The three hospitals are equidistantly located. Patients are uniformly allocated between the hospitals. The figure illustrates the hospital market.

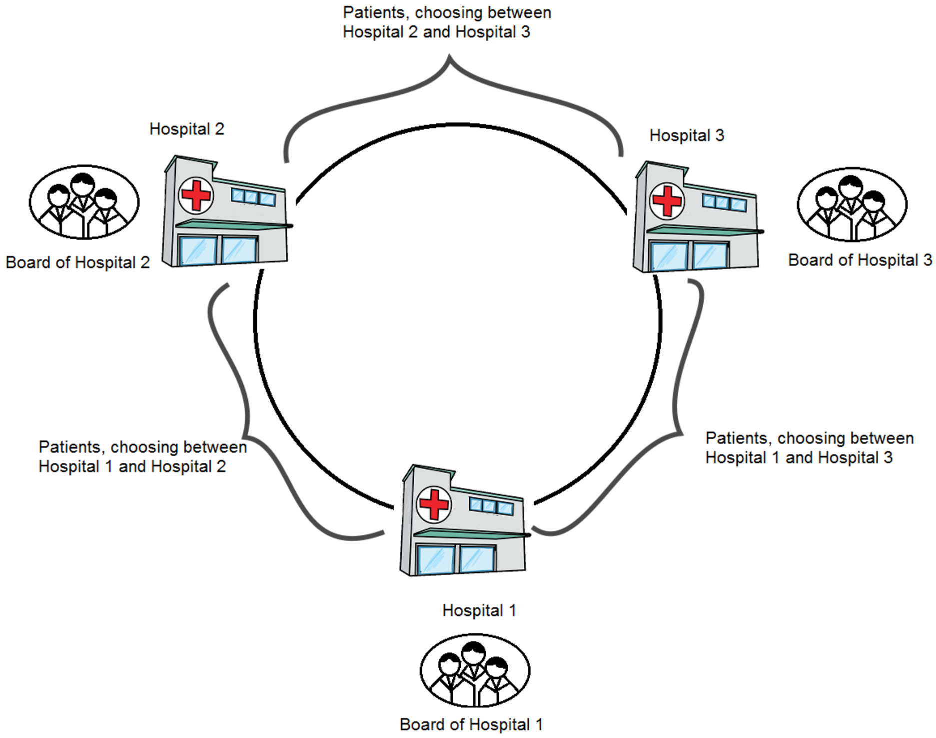


Figure in Team Treatments

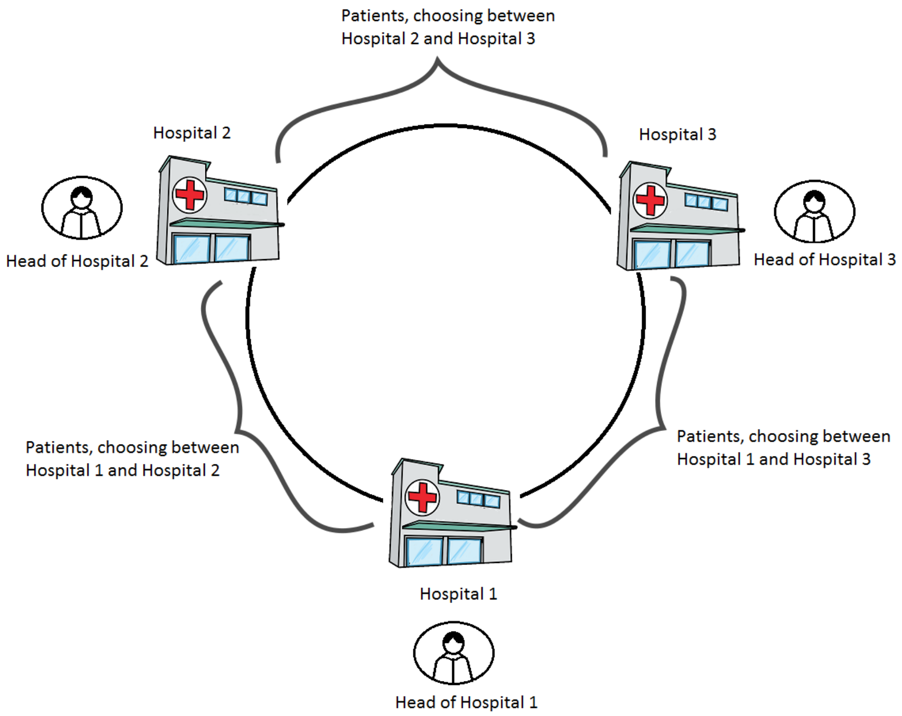


Figure in individual treatments

The profit of your hospital depends on the number of treated patients. Due to the uniform distribution, the number of patients in the catchment area of each hospital is equal. Patients prefer short distances and high quality levels. Thus, patients will choose their hospitals by weighing quality levels against the distance of the respective hospital.

The location of your hospital is fixed, hence the quality level is your only means to make yourself attractive to patients. Accordingly, the number of treated patients will depend on the quality level of your hospital relative to the quality levels of the other two hospitals.

As catchment areas of the hospitals overlap, competition for patients can occur. Given equal distances, a patient will choose the hospital with the higher quality level. The preference for short distances also implies that a patient located between two hospitals will always choose one of these two.

In the beginning of the experiment, you will be randomly matched to a hospital market with *eight other* **[two other]** participants for the course of the experiment. *Two of them will be on the board of the hospital with you. The other six participants will be in the boards of the other two hospitals. Each participant decides on the hospital's quality level in the role of a board member.* [**Each participant will be in charge of a hospital and decide on the hospital's quality level.]**

Description of decision rounds

There are 15 decision rounds in part 1. Each round is payment relevant and your quality decisions will affect your own profit and an amount of money that is paid to real patients outside the lab.

In each round, you have to choose the quality level of your hospital *with the other two board members*. The other *two hospital boards* **[heads]** simultaneously make their own quality choices for their respective hospital. You can choose between 13 quality levels (1,2,3, … , 11,12,13), where 1 is the lowest and 13 is the highest quality level. You can only pick integers. A higher quality level is associated with higher costs. Since patients prefer higher quality levels, you can influence the number of patients treated at your hospital by the quality choice. Thus, the market shares of the three hospitals depend on their relative quality levels. Hospitals receive a fixed payment for each treated patient.

Patient benefit is composed of the quality level of the hospital where they are treated minus the cost of traveling to the hospital. Hence, patient benefit increases with higher quality levels and decreases with higher costs of travel. In this experiment it will be displayed as a monetary value

and also called “patient utility”. The sum of patient utility will be paid out to real patients after the experiment ends.
For an illustration of this context and as assistance for your decision making a profit- and patient utility-table as well as a profit and benefit calculator are provided to you.

Profit- and patient utility table

The profit table and patient utility table were handed out with the instructions. It serves to give you an overview of the context.
From the profit table you can learn how profits are distributed among the hospitals given the choice of the other two hospitals. Costs from higher quality and changes in market shares are already included. The bold values with white background color in each row display your hospital’s profit for each quality level. The profit depends on your quality level relative to the ones of the other two hospitals in the market. The grey shaded columns display the profits of the other two hospital given that they choose uniform quality levels.
The profit is shared evenly among the hospital board members. In other words, your own payment equals one third of the values in the table.

The patient utility table provides you with information about contributions to patient utility given various choices of quality level. The structure and way of reading is equivalent to the profit table. For different combination you can learn about the contributions of a hospital to patient utility given uniform quality choices of the other two hospitals. The patient utility is shown as a monetary value and can be interpreted as a payment to the patient.
Correspondingly, the table gives you an overview how decisions about quality levels affect the profits of hospitals and patient utility.
Please note that the tables only provide you with information for uniform quality choices of the other two hospitals. Cases where the other two hospitals choose different quality levels can be simulated with the profit- and patient utility calculator.

Profit- and patient utility calculator

A calculator will be displayed on the left hand side of your screen in every decision round. You can use this calculator to calculate profits and patient utility for every possible constellation, i.e. situations which are included in the tables as well as those not included. You can use the calculator by typing in your quality choice and hypothetical choices of the *other two hospital* *boards* **[participants]** and clicking "Calculate". The profits and respective contributions to patient utility of your hospital and the other two hospitals will be displayed afterwards. Like the tables, the calculator simply serves to assist you in your decision-making.

Decision about quality level

When you have decided on the quality level, type in your choice on the right hand side of the screen and propose it to your other two board members by clicking „Propose". They will also submit their quality proposals. After all three proposals have been submitted, they will be shown to all board members. In case of two (or more) equal proposals, this proposal is chosen and determined to be the quality level of the hospital for this round. In case of three different quality proposals, the voting procedure is repeated until a majority for a quality proposal is obtained. **[When you have decided on the quality level, type in your choice in the field „Quality level" on the right hand side of the screen and click „Select". The heads of the other two hospitals will also choose their quality levels.]**

Information

Patients` hospital choice is simulated based on the decisions of the three hospitals after every round. Then, you receive information about the other two hospitals` quality levels and the resulting profits for every hospital. *The profit is split evenly between the board members. Your individual payment equals one third of the hospital profit and will be displayed as well.* Additionally, you will be informed about your hospital's contribution as well as the other two hospitals' contributions to patient utility. From the history table you can derive the hospitals' individual decisions, corresponding profits and contributions to patient utilities.

Payment

At the end of the experiment the profits of each round are summed up and converted in Euro. Each participant is paid *his individual share of hospital* [**out the profit of his hospital]** profit in cash.

For this part of the experiment, no patients are physically present in the laboratory. The patient utility generated by your hospital's quality choices in each round goes to real patients: The sum all rounds will be transferred to domestic projects of Ärzte der Welt e.V. (Doctors of the World), 80807 Munich. In these projects individuals in Germany without health insurance or access to the regular healthcare system receive basic medical treatment. Ärzte der Welt e.v. holds the DZI

Spendensiegel (DZI seal of approval) which certifies transparent, goal oriented and economic use of donations.

The transfer of money to the Ärzte der Welt e.V. will be carried out by the experimenter and one control person after the experiment. The control person completes a money transfer form by filling in the total patient benefit (in Euro) resulting from the realized contributions to patient utilities over all decision rounds. The payment of this amount is then handled by the finance department of the University of Duisburg-Essen, which will transfer the payment from the designated budget fro this experiment to the Ärzte der Welt e.V. The form is then sealed in a stamped envelope and deposited in the nearest mailbox by the control person and and the experimenter.

After the part 2 of the experiment is completed, one participant is randomly chosen to be the control person. The control person receives an additional compensation of 5 Euro for this task. The control person certifies that the process has been completed as described here by signing a statement that can be looked at by all participants at the office of the health economics research center CINCH. Moreover, upon request you may also take a look at the donation receipt from Ärzte der Welt e.V.

Comprehension questions

Prior to the decision rounds we kindly ask you to answer a few comprehension questions. These comprehension questions are intended to help you familiarize yourself with the decision situations. In case you have any questions, please raise your hand. Part 1 of the experiment will begin once all participants have answered the comprehension questions correctly.

A.3. Semi-altruism in the experimental design

To get a clearer idea how the theoretical considerations about strategic complement and substitutes translate into expectations for the experiment, we consider our experimental parameters. Table A.1 displays the market demand, as well as the absolute and relative contribution to patient utility (PU) for every possible quality choice by a participant in response to the rivals' average quality level of either 1 or 13.[28] The first two rows show the demand a hospital faces when it responds to the rivals' average quality choice of either 1 or 13. In case it responds with a quality level of 1 to an average quality of 1, the market is symmetric and every hospital has a market share of 0.33. The higher it sets its own quality level (c.p.), the higher its market share until up to 0.67 at a quality level of 13. If both rivals set a quality of 13, a hospital can at best (in terms of market share) match their quality of 13 which results in an even split of 0.33 each. In case it chooses a lower quality level, it will face a lower demand with a market share of 0 when it chooses a quality of 1.

Table A.1 Effects of quality response (1-13) to rivals' average quality level (1 or 13) on market share, absolute and relative contribution to patient utility

	Quality	1	2	3	4	5	6	7	8	9	10	11	12	13
Market	1	0.33	0.36	0.39	0.42	0.44	0.47	0.50	0.53	0.56	0.58	0.61	0.64	0.67
Share	13	0.00	0.03	0.06	0.08	0.11	0.14	0.17	0.19	0.22	0.25	0.28	0.31	0.33
PU	1	1.00	1.35	1.75	2.19	2.67	3.19	3.75	4.35	5.00	5.69	6.42	7.19	8.00
(abs.)	13	0.00	0.19	0.42	0.69	1.00	1.35	1.75	2.19	2.67	3.19	3.75	4.35	5.00
PU	1	0.33	0.40	0.47	0.53	0.59	0.64	0.68	0.72	0.76	0.80	0.83	0.86	0.89
(rel.)	13	0.00	0.01	0.03	0.05	0.08	0.10	0.13	0.16	0.19	0.23	0.26	0.30	0.33

Note: Patient Utility in the experimental currency Taler for a given period.

Moreover, rows 3 and 4 of Table A.1 show the absolute monetary patient utility that a hospital contributes with its respective quality responses. Irrespective of the rivals' average quality level of 1, a higher quality level always leads to a higher patient utility. The latter ranges from 1 to 8 Taler in response to the rivals' average quality level of 1 and from 0 to 5 ECU in response to the rivals' average quality level of 13. More is always better but the range or impact is bigger when the rivals set a low quality, which is in line with the previous discussion.

[28] Note that we chose to present these two extreme quality levels to highlight the contrast.

This is also reflected in rows 5 and 6 that show the relative contribution of a hospital to the total patient utility in the market. We can see that a participant can contribute almost 90 percent of the patient utility if he chooses quality level of 13 while the rivals choose on average 1. On the other hand, he can at most contribute 33 percent for the same quality level of 13, when the others also contribute on average 13. If this relative impact on patient utility is important to an altruistic provider, the incentive to provide high quality could decrease with an increasing average quality level by the other hospitals in the market..

A.4 Robustness Checks Regarding Collusion and Altruism

So far, our analyses show that there is hardly any tendency towards collusion (JPM) on aggregate in both individual and team markets. A way to describe collusion is a joint deviation from the competitive benchmark, which would be 10 in our case, towards the monopoly or JPM outcome (Motta, 2004). We will have a look at two values from this collusive region. First, we take a quality level of 4 or lower (i.e. lower than 5 or 6 which would be the optimal deviation to collusion) as the critical collusion value.[29] We will also look at a quality level of 7 or lower which would be the symmetric counterpart (0.33) for the degree of cooperation to the minimum of -0.33 at the patient optimum.

We can see from Table A.2 that there is not a single market out of 38 in the team conditions that plays collective collusive qualities in one of the 15 periods, neither for a quality threshold of 4 or 7. In the individual conditions, 67 out of 71 markets (more than 90 percent) do not collude collectively over the 15 periods. One market manages to play to collusive periods for 12 periods while four markets collude between 1 and 3 periods. If we relax the quality threshold to 7, still 86 percent of the individual markets do not have a single collusive period.

Table A.2: Number of Markets by Collusive Periods (Quality Level ≤ 4 and ≤ 7)

	Number of collusive periods out of 15 within a market (quality level ≤ 4)					
	0	1	2	3	12	Total
Individual	67 (94.37%)	1 (1.41%)	1 (1.41%)	1 (1.41%)	1 (1.41%)	71
Team	38 (100%)	0	0	0	0	38
	Number of collusive periods out of 15 within a market (quality level ≤ 7)					
Individual	61 (85.92%)	2 (2.82%)	2 (2.82%)	2 (2.82%)	2 (2.82%)	71
Team	38 (100%)	0	0	0	0	38

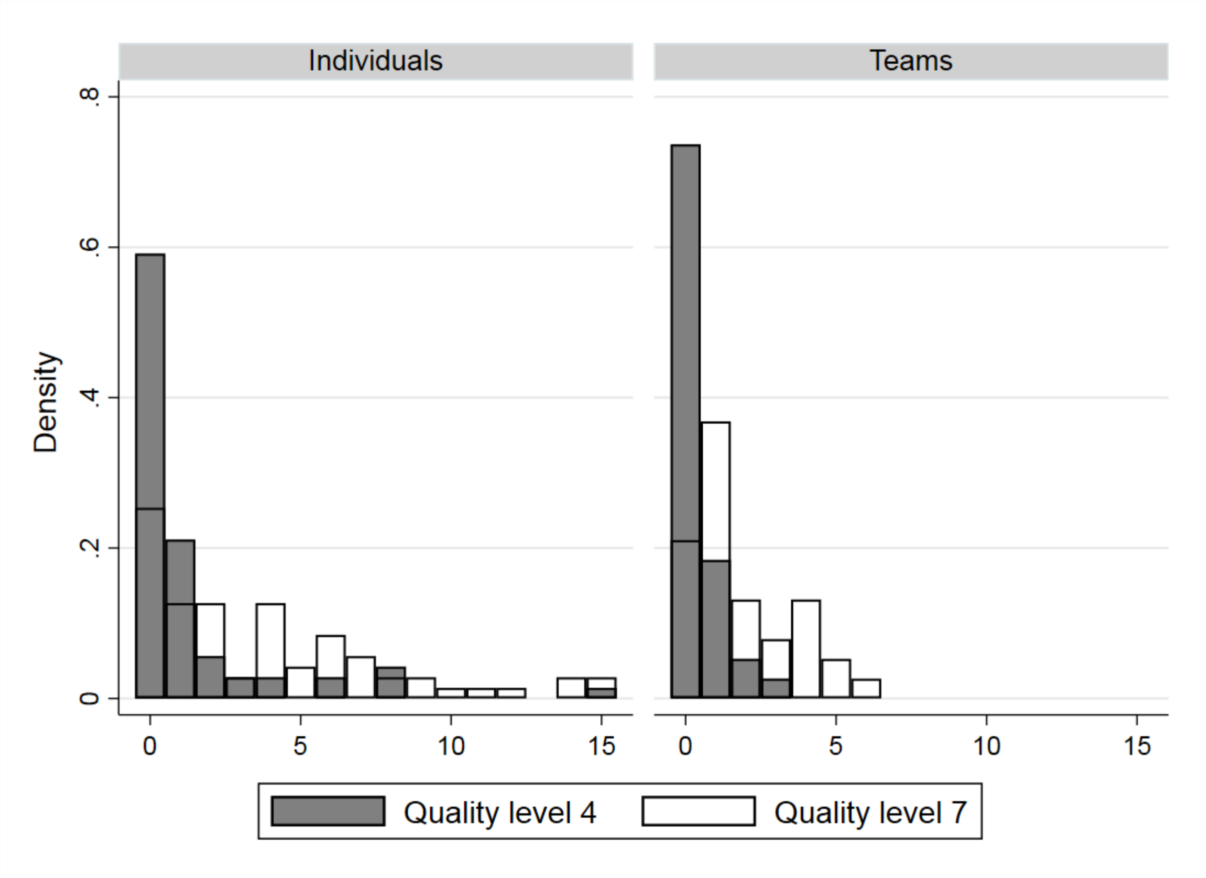
[29] In Appendix 3 we show additional results for a threshold value of 9 which is just below the uncooperative Nash equilibrium.

What could explain the lack of collusion? Did no one initiate a collusion? Maybe the lack of collusion is simply caused by lack of collusion attempts. To answer this question, we look whether at least one hospital set a quality level of 4 or lower in a given period.

Figure A.1 shows the distribution of collusion attempts with a threshold quality level of 4 (grey bars) and 7 (white bars) over 15 periods for the respective markets in individual conditions (left) and team conditions (right). Applying the strict collusion definition of 4, in the individual condition, around 60 percent of the markets had 0 collusion attempts. In the team treatments, more than 70 percent of markets do not have a single collusion attempt. There are a few more outliers in the individual market with one market with a collusion attempt in every period. Overall, however, the distribution is not significantly different (MWU, p=0.0803). With the relaxed collusion threshold of 7, we observe significantly more collusion attempts in the individual treatment compared to the team treatment (MWU, p=0.0328).

These observations confirm the idea that the team decision process filters out extreme quality choices. It makes collusion attempts much harder if we take a stricter quality threshold because subjects first have to `convince' the other team members to attempt a collusion. Also, if collusion fails it is likely much harder to convince them to try again. Another explanation might be that in the individual conditions participants only have *rivals* or *competitors* while in the team conditions there is the emphasis on *team*. While the experiment was anonymous, it might be that individuals care more about the opinion or social acceptance by team mates than by rivals and refrain from playing low qualities

Figure A.1: Distribution of Collusion Attempts within 15 periods (0 ist Individual; 1 ist Team)



Altruism or Competitiveness

Given that we only find little evidence for collusive behavior on the JPM, we now investigate markets on the other side of the quality spectrum indicating patient centeredness or altruism. The symmetric Nash equilibrium quality is 10. Markets that uniformly play (even) higher qualities might have non-profit-oriented or non-competitive reasons for doing so. While a single occurrence of three simultaneous qualities above 10 might be the outcome of some deviation punishment, consistent plays in this region might explain altruistic behavior.

Similar to our collusion analysis we consider the number of periods where the whole market chose qualities higher than 10. From Figure A.2 we can see that about 25 percent of markets in the individual conditions did not have a single period where all hospitals set a quality higher than 10. In the team conditions only about 10 percent of the markets do not have a unanimously patient oriented period over the whole duration. The difference, however, is not significant (MWU: p=0.2589).

Figure A.2: Number of Periods with Altruistic Quality Choices > 10 in markets (0 individual; 1 team)