Southern Economic Journal 2018, 85(1), 255–275
DOI: 10.1002/soej.12278

Why Factors Facilitating Collusion May Not Predict Cartel Occurrence — Experimental Evidence

Miguel A. Fonseca,* Yan Li,† and Hans-Theo Normann‡

Factors facilitating collusion may not successfully predict cartel occurrence: When a factor predicts that collusion (explicit and tacit) becomes easier, firms might be less inclined to set up a cartel simply because tacit coordination already tends to go in hand with supra-competitive profits. We illustrate this issue with laboratory data. We run *n*-firm Cournot experiments with written cheap-talk communication between players and we compare them to treatments without the possibility to talk. We conduct this comparison for two, four, and six firms. We find that two firms indeed find it easier to collude tacitly but that the number of firms does not significantly affect outcomes with communication. As a result, the payoff gain from communication increases with the number of firms, at a decreasing rate.

JEL Classification: L42, C90, C70

1. Introduction

Lists of factors facilitating collusion play a popular role in the industrial organization literature and in antitrust policy.[1] Typical items on those lists include the fewness of firms (or industry concentration),[2] product homogeneity, firm symmetry, or regular orders. For any of these factors (and others), the notion is that, other things being equal, collusion is more likely. The impact of such factors is very intuitive and can be rigorously derived with simple repeated-game analysis.

Despite their popularity, the power of factors facilitating collusion in predicting cartel occurrence is limited. Empirical research studying whether the factors correlate with the frequency of detected cartels (Posner 1970; Hay and Kelley 1974; Grout and Sonderegger 2005; Levenstein and Suslow 2006) do not report clear-cut results. This is particularly the case for the alleged correlation

* University of Exeter Business School, Streatham Court, Rennes Drive, Exeter EX4 4PU, UK and NIPE, Universidade do Minho; E-mail: m.a.fonseca@exeter.ac.uk.

† University of Liverpool Management School, Chatham Building, Chatham Street, Liverpool L69 7ZH, UK; E-mail: yan.li3@liverpool.ac.uk.

‡ Duesseldorf Institute for Competition Economics, Heinrich-Heine-Universitaet Duesseldorf Universitaetsstr. 1, 40225, Duesseldorf, Germany; E-mail: normann@dice.hhu.de; corresponding author.

Received August 2017; accepted May 2018.

[1] See, for example, Scherer (1980, ch. 7 and 8), Tirole (1989, ch. 6), Martin (2001, ch. 10), Motta (2004, ch. 4.2), and Belleflamme and Peitz (2015, ch. 14). See also the treatment by Ivaldi et al. (2003).

[2] Concentration and number of firms will be correlated but they may not always be addressed by the same facilitating factor: more concentrated industries may be less symmetric and therefore, all else equal, less prone to collusion.

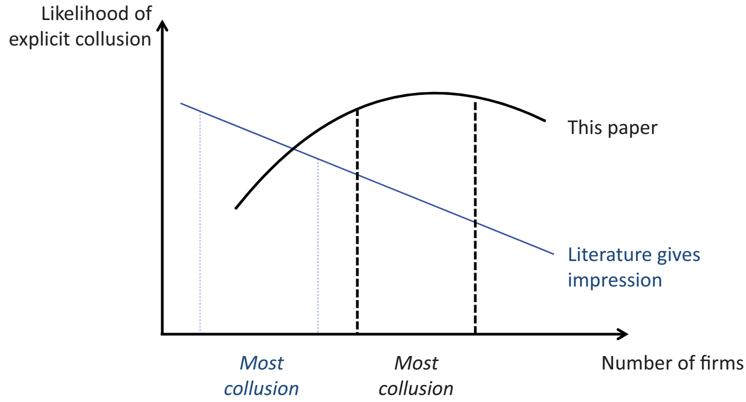

Figure 1. The Number of Firms and the Likelihood of Collusion. [Color figure can be viewed at wileyonlinelibrary.com]

between cartel frequency and concentration or the number of firms.[3] It appears that facilitating factors are by no means reliable structural indicators of cartel occurrence, although as Stigler (1970) suggests, it may be that samples of detected cartels are biased in one way or another.

Why do facilitating factors not reliably predict cartel frequency? Any facilitating factor may apply to both explicit (cartel-like) agreements and implicit (tacit) coordination. The repeated-game incentive constraint—say, of a trigger strategy equilibrium—is a necessary condition for cooperation to emerge as a subgame perfect equilibrium in both settings. If, for example, collusion is easier with fewer firms, this will be true for legal tacit coordination and for illegal explicit cartels. But why should firms be more inclined to engage in illegal price-fixing when they find it *easier* to cooperate tacitly? Instead, there may well be fewer cartels in concentrated industries, not more; or this relationship may be nonmonotonic.

Put differently, the reason why facilitating factors are not good predictors of cartel activity is that the decision to set up a cartel should be driven by the *additional* profit the cartel leads to, taking into account fines and the foregone profit when firms do not talk. How big the additional profits from cartel-like communication are over and above the profit obtained from tacit agreements is an entirely different question. Ex ante, it is not clear at all that facilitating factors are a good predictor of this extra margin.

Figure 1 illustrates the issue. The literature gives the impression that, the fewer the firms, the more explicit collusion is to be expected (downward sloping line). This conclusion is consistent with the idea that fewer firms will find it easier to collude. However, it ignores that explicitly colluding is costly. The costs of a cartel include the opportunity cost from coordinating tacitly, organizational costs, and cartel fines. We will argue that while more firms may benefit more strongly from explicitly talking, the gain from talking might eventually decline such that a medium number of firms benefits the most from colluding (concave curve).

[3] To illustrate this puzzling finding, we quote here from various studies. Posner (1970) concludes that "[a] large proportion [of the cartels were] in industries not normally regarded as highly concentrated," Hay and Kelley (1974) find that "in many cases larger groups conspire." In a report for the British OFT, Grout and Sonderegger (2005) state about several facilitating factors that "[i]ndeed, there is some element of disconnection between the predictions and the variables that are relevant here." And Levenstein and Suslow (2006) find "no simple relationship between industry concentration and the likelihood of collusion."

In this article, we demonstrate the force of this argument with data from laboratory experiments. We study one facilitating factor, namely the number of firms, and we demonstrate with these data that such facilitating factors are not suitable for cartel detection. We run n-firm repeated Cournot oligopoly experiments with and without communication with the goal of measuring the gain from communication as a function of n. Specifically, markets with two, four, and six firms which either cannot communicate at all or communicate via a messenger-type tool. A between-subjects comparison of the profits earned for each n then quantifies the gain from communication.

Evidence for communication makes a fundamental difference in cartel cases, but economic theory is currently not well equipped to justify this distinction or explain exactly how communication facilitates cartel coordination. Regarding the notion that communication is the defining element of a cartel, Whinston (2008) notes that "*[i]t is in some sense paradoxical that the least contested area of antitrust is perhaps the one in which the basis of the policy in economic theory is weakest.... it would be good if we understood better the economics behind this.*" In our experiments we explore how and to what extent communication supports collusion by quantifying of the gain from communication in Cournot oligopoly.

We believe that laboratory experiments are useful to examine "tacit vs. explicit collusion." In the lab, we control the communication conditions rigorously. While we do not consider lab experiments to be a substitute for field data cartel studies, it seems to us that the polar cases of no communication and communication occur in the lab in an clean manner, which is difficult to match with other types of data.

We find that duopolists indeed find it easier to collude without communicating than subjects in markets with more firms. But since the number of firms does not significantly affect outcomes with communication, the payoff gain from communication increases with the number of firms at a decreasing rate. That is, markets with more firms gain less from explicit communication.

2. Literature

The literature has firmly established that communication facilitates cooperation in social dilemmas. Deutsch (1958) finds in a prisoner's dilemma experiment that communication before the start of the game leads to more cooperation. One of the earliest contributions to experimental economics, Friedman (1967), reports on a number of Cournot duopoly experiments where communication is allowed, and finds that subjects often coordinate on the joint-profit maximum. Since then, many studies of this type have confirmed this result. Examples include Isaac, Ramey, and Williams (1984), Isaac and Walker (1988), Cason and Davis (1995), and Davis and Holt (1998). Further research has established that the exact form of communication is important (Brosig, Ockenfels, and Weimann 2003), but, overall, it has been established that talking helps.[4]

Whereas there are several studies analyzing how the number of players affects the degree of cooperation (Fouraker and Siegel 1963; Dolbear et al. 1968; Davis and Holt 1994; Huck, Normann, and Oechssler 2004), little work with communication has been done in this area. Binger, Hoffman, and Libecap (1990) compare two and five firms in Cournot markets with and without communication. Their results are difficult to compare to more recent studies because subjects

[4] Landeo and Spier (2009) demonstrate anticompetitive effects of communication in the context of exclusive dealing. See also Boone, Müller, and Suetens (2014).

communicated face-to-face. Waichmann, Requate, and Siang (2014) compare Cournot markets with two and three firms using both students and managers as subjects. In addition to free communication, they also investigate a more standardized form of chat (preformulated messages). They find that students are affected by the type of communication whereas managers are not. Under standardized communication, managers select lower outputs than students, but there are no differences in subject pools under free communication. Finally, they observe more collusion in the duopolies than in the triopolies. Harrington, Hernan Gonzalez, and Kujal (2016) study the effect of firm numbers (mainly two vs. three) in markets with price-setting firms, with and without communication. Following Holt and Davis (1990), they also study (nonbinding) price announcements as an intermediate form of communication. They find that explicit communication leads to near-monopoly prices throughout. Announcements have only moderate effects, and only for duopolies.

Balliet (2010) conducts an interesting fully fledged meta study of the effects of communication in dilemma games. The effect sizes he reports are the mean differences in cooperation between no communication and communication. Regarding our research question, Balliet (2010) finds that the effect of communication is stronger in larger groups. We will return to this result in our conclusion.[5]

The closest article to our present study is Fonseca and Normann (2012), which analyzes the gain from communication for symmetric Bertrand oligopolies in lab experiments. They conduct experiments with two, four, six, and eight firms and find an inversely u-shaped relationship between the number of firms and the incentive to collude. Our study differs from Fonseca and Normann (2012) in two aspects. First, we analyze strategic substitutes (homogeneous Cournot competition) whereas they analyze strategic complements (homogeneous Bertrand). A recent study by Mermer, Mueller, and Suetens (2016) shows for two-player experiments without communication that collusive outcomes differ significantly between the two formats, which motivated us to study the environment with collusion. Second, we use novel text-mining methods to perform an in-depth analysis of the communication between players, thus making a contribution to the literature on preplay communication in games.

3. Experimental Design and Hypotheses

We run Cournot oligopoly experiments with an inverse demand function of $p = 100 - Q$. Firms have marginal costs of $c = 1$. We selected this set of parameters for two main reasons: comparability to Huck, Normann, and Oechssler (2004), and the fact that they made the computation of payoffs easy to subjects in the absence of a payoff table.[6]

We run a 3×2 factorial design, summarized in Table 1. The first treatment variable is the number of firms, n. We use oligopolies with $n \in \{2, 4, 6\}$ firms.[7] Our second treatment variable is

[5] Balliet (2010, p. 52) concedes that his study had too few larger groups to provide a thorough test and that future research would benefit from studying larger groups. This is what our experiment does.

[6] Designing an experiment with varying the number of players introduced tough methodological issues. Varying the number of firms means that using a payoff table would have forced us to restrict the set of quantities to be small. For instance, giving firms only three output levels, would result in a overly large payoff table as there are rather many potential quantities a firm's five competitors may produce. Furthermore, having different treatments with different payoff table sizes could have introduced a confound by making some treatments cognitively harder.

[7] Our hypotheses suggest that these are indeed the relevant treatments. Moreover, in treatments with, say, eight or more firms, even minor fluctuations around the static Nash equilibrium may end up with subjects incurring losses.

Table 1. 3 × 2 Factorial Treatment Design, Treatment Labels, and Number of Markets (and Participants) for Each Treatment Cell

	Communication	
Number of firms	No	Yes
$n = 2$	No-Chat-2 9 (18)	Chat-2 9 (18)
$n = 4$	No-Chat-4 9 (36)	Chat-4 9 (36)
$n = 6$	No-Chat-6 6 (36)	Chat-6 6 (36)

the opportunity to communicate. In the treatments without communication (labeled No-Chat), subjects had to post quantities in each period without being able to communicate with each other. In the communication treatments (labeled Chat), subjects were allowed to communicate in each period via typed messages, using an instant-messenger communication tool. Communication was unrestricted and subjects were allowed to exchange as many messages as they liked. However, they were not allowed to identify themselves. The time to communicate was limited to one minute in the first period and 30 seconds thereafter.

The experiments were implemented as a repeated game. There was a minimum number of 20 periods; after period 20, play continued for another period with a 5/6 probability. The continuation procedure was implemented with a random computer draw. The actual number of periods was determined ex ante and was the same in all sessions and treatments (namely 24). Each subject participated in one repeated game only. Players were always matched with the same partner (fixed matching).

Table 2 summarizes the numerical predictions. In the Appendix, we provide a more general analysis; we also do a comparative-statics analysis of n. Our first benchmark are the static Nash equilibrium predictions (first row). If firms successfully coordinate on the symmetric joint-profit maximum, quantities in the second row will materialize. Rows three and four contain the profits corresponding to the static Nash equilibrium and the symmetric joint-profit maximum.

The conventional wisdom that fewer firms will find it easier to collude can be derived formally in the repeated game (see the Appendix). Row five of Table 2 shows the minimum discount factor, δ, required to sustain the symmetric joint-profit maximum as a subgame perfect Nash equilibrium in the infinitely repeated game. This incentive constraint is a condition that necessarily has to be met for the collusive outcome to be subgame perfect, regardless of whether players

Table 2. Predictions

	$n = 2$	$n = 4$	$n = 6$
Static Nash q_i	33.00	19.80	14.14
Symmetric collusive q_i	24.75	12.38	8.25
Static Nash Π_i	1089.00	392.04	200.02
Symmetric collusive Π_i	1225.13	612.56	408.38
Minimum discount factor, δ	0.529	0.610	0.671
Gain from talking, $\Delta\Pi$	272.25	882.09	1250.13

Notes: “Nash q_i” refers to the firm-level output in the one-shot equilibrium, “Collusive q_i” refers to firm-level output in the symmetric joint-profit maximum, δ is the minimum discount factor required in a repeated game with Nash trigger, and the “Gain from talking” refers to the extra profit firms earn when colluding summed across all firms communicate explicitly. Furthermore, such incentive conditions are often interpreted as an indicator of how "difficult" collusion is. Thus, we have theoretical support for:

Hypothesis 1. The fewer the firms, the easier they find it to collude both (i) tacitly and (ii) explicitly.

Experimental evidence as well as antitrust practice suggests that firms benefit from talking (see the introduction and the end of this section). We thus formally hypothesize that the gain from talking is positive:

Hypothesis 2. Communication has a collusive effect.

We now turn to the main point of the article, the gain from communicating. Let π_i^{Chat}, $i=1, \ldots, n$ denote the profit each firm makes when engaging in explicit communication, and let $\pi_i^{No-Chat}$, $i=1,\ldots,n$, denote the profit without explicit communication.[8] Then the gain from communication for a market of n firms is

$$\Delta\Pi=\sum_{i=1}^{n}\left(\pi_i^{Chat}-\pi_i^{No-Chat}\right). \tag{1}$$

In words, this is the amount of money the firms in an industry would put on the table in order to be able to talk.

Standard repeated-game theory is probably not well-equipped to predict a gain from communicating (Harrington 2008; Whinston 2008). The incentive constraint of the repeated game (see the Appendix) merely reflects the incentives to deviate from a given collusive equilibrium. Whether firms coordinate on such an equilibrium with or without communication is immaterial. Importantly, even if it turned out that π_i^{Chat} and $\pi_i^{No-Chat}$ decline in the number of firms, this does not suggest a relationship between n and $\Delta\Pi$. The difference between two monotonically declining functions can be anything, so $\Delta\Pi$ could be increasing, decreasing or nonmonotonic in n.

In order to get more structure into this problem, we assume that without communication firms do not manage to sustain collusive output levels at all whereas they perfectly collude on the monopoly output when they are allowed to talk. If so, the profits in rows three and four of Table 2 would occur and we can calculate $\Delta\Pi$ (see row six, and the Appendix for a general analysis). We formalize:

Hypothesis 3. The gain from talking, $\Delta\Pi$, (i) increases monotonically in n, and (ii) it does so at a decreasing rate.

Note again how δ and $\Delta\Pi$ capture the ambiguous and apparently contradictory notion of "facilitating collusion." The minimum discount factor indeed suggests that fewer firms find it easier to collude. The gain from explicit chat, however, is higher for four and six Cournot firms than for duopolies.[9] Therefore, even though fewer firms may find it easier to collude, this does by no means imply that there will be more cartels with fewer firms.

[8] See, for example, Aubert, Rey, and Kovacic (2007) for just such a model of cartel formation. In their model, Cartel-like communication is detected and fined with a certain probability. We will keep these factors outside our model.

[9] With perfect Bertrand competition, $\sum \pi_i^{No-Chat}$ would be zero and $\sum \pi_i^{Chat}$ would be at the profit maximum. But then $\Delta\Pi$ would be constant, regardless of n.

To what extent do we need to modify our hypotheses on $\Delta\Pi$ in light of previous Cournot experiments? For Cournot markets with communication, Huck, Normann, and Oechssler (2004) found that duopolies show some level of tacit coordination, but oligopolies with four or more firms converge to the Nash equilibrium or are even more competitive.[10] Evidence on n-firm Cournot oligopoly with communication is less abundant but Normann, Rösch, and Schultz (2015) analyze three-firm Cournot markets with (unstructured) communication; they report near perfect monopolization. Gomez-Martinez, Onderstal, and Sonnemans (2016) report lab experiments with differentiated Cournot competition and find that subjects in four-firm markets cooperate close to the joint-profit maximizing level. Waichmann, Requate, and Siang (2014) confirm the above results without communication but observe less collusion with talk. While acknowledging that we know little about Cournot markets with more than four firms, it appears the existing experimental evidence strengthens our hypothesis that $\Delta\Pi$ increases in n.

4. Procedures

We provided written experimental instructions which informed subjects of all the features of the market (the instructions are available in the Appendix). Subjects were told they were representing one of two, four, or six firms, respectively, in a market. The instructions notified the participants of the market parameters in an informal manner. Two concrete examples illustrated the profit calculations.

In every period, subjects had to enter a quantity $\in \{0, 100\}$ in a computer interface.[11] Once all subjects had made their decisions, the period ended and a screen displayed the quantity choices of all firms and the market price. The screen also displayed the individual payoff of the current period and the accumulated payoffs up to that point but not the payoffs of the other firms.

Treatments were incentivized and payments were made as follows. Since losses are possible in this game, we decided to give subjects an initial capital corresponding to four euros. We used an experimental currency unit ("Taler") and different exchange rates for each market, namely 2,000 Taler for one euro for the duopolies, 1,000 Taler for the four-firm markets and 750 Taler for the six-firm markets. The varying exchange rates are warranted here because the pie (or the market size) is constant in this experiment whereas the number of players is not. Payments were made at the end and in cash and consisted of the initial capital and the sum of the payoffs attained during the course of the experiment.

Subjects were recruited from a pool of potential participants using the online system ORSEE (Greiner 2015). The experiments were computerized, using z-Tree (Fischbacher 2007), and were conducted at the DICElab of Heinrich-Heine University in 2013 and 2014. A total of 180 subjects participated in 10 sessions (two duopoly sessions and four sessions each for the $n = 4$ and $n = 6$ treatments). Sessions lasted between 45 and 65 minutes. Average earnings were 15.39 euros and ranged from 9.26 euros (No-Com-6) to 18.86 (Com-2).

[10] Consistent with the experimental evidence, Li and Lyons (2012) find for telecommunication industries that market structures with more than three firms lead to major improvements in competitiveness.

[11] As is well known, there are additional equilibria in Cournot oligopoly when the action space is discrete (Holt 1985). These additional equilibria are close to the prediction made in Hypothesis 3 (at most one unit distance) and, moreover, may imply the same average quantities. For example, with $n = 2$, $q_1 = 34$ and $q_2 = 32$ are mutual best replies but, the average is 33, as with continuous actions.

Table 3. Average Quantities and Profits, (Std. Dev.) and Prediction (Static Nash for No-Chat, Symmetric Joint-Profit Maximum for Chat)

	$n=2$		$n=4$		$n=6$	
	No-Chat	Chat	No-Chat	Chat	No-Chat	Chat
q_i	28.86	24.84	19.22	12.01	14.94	9.01
	(2.95)	(0.86)	(2.35)	(0.90)	(0.74)	(0.95)
prediction	33.00	24.75	19.80	12.38	14.14	8.25
π_i	1130.66	1214.45	386.26	596.41	164.23	382.19
	(76.29)	(9.62)	(110.82)	(24.59)	(33.85)	(36.15)
prediction	1089.00	1225.13	392.04	612.56	200.02	408.38
# obs	9	9	9	9	6	6

5. Results

Treatment Effects

Table 3 reports average quantities and profits conditional on the number of firms and whether or not communication was possible. It also reports the Cournot-Nash benchmark and the symmetric joint-profit maximum.

Average quantities in the No-Chat condition are significantly below the Cournot-Nash level in $n=2$ ($z=2.666; p=0.008$, Wilcoxon signed-rank test (WSR); not statistically different from Nash in $n=4$ ($z=-0.770; p=0.441$, WSR test) and slightly above Nash for $n=6$ ($z=1.782; p=0.075$, WSR test). These findings are consistent with results reported in Huck, Normann, and Oechssler (2004).

We further observe a positive relationship between the number of firms and industry output. A Jonckheere-Terpstra test (JT) rejected the null of the joint equality of outputs against an ordered alternative in either direction ($J^*=2.089$, $p=0.038$). This is consistent with Hypothesis 1 (i).

Observation 1 (i): Without communication, the fewer the firms, the easier it is to collude tacitly.

With communication, average quantities were very close to, and not statistically different from, the collusion benchmark in all market structures ($n=2$: $z=0.771, p=0.441$; $n=4$: $z=-1.007, p=0.314$; $n=6$: $z=1.572, p=0.116$, WSR, test). Along the same lines, we no longer observe any statistically significant relationship between industry output and the number of firms (JT, $J^*=0.000, p=0.500$, for either of the two ordered alternatives).

Observation 1 (ii): With communication, the number of firms does not affect the level of collusion.

Consistent with Hypothesis 2, allowing participants to communicate leads to a significant reduction in average quantities across all treatments ($n=2$: $z=2.475, p=0.013$; $n=4$: $z=3.576, p < 0.001$; $n=6$: $z=2.882, p=0.004$, Wilcoxon rank-sum, WRS, test). Consequently, firms earned higher profits in the Chat conditions than the No-Chat conditions ($n=2$: $z=2.209$, $p=0.027$; $n=4$: $z=3.488, p < 0.001$; $n=6$: $z=2.882, p=0.004$, WRS test).

Observation 2: The opportunity to communicate leads to lower quantities and higher profits.

Careful observation of Table 3 shows that communication not only decreases average firm quantities but it also reduces their dispersion. Figure 2 provides visual confirmation of this, each (independent) group being one observation. Conditional on group size, average quantities are lower under communication, and dispersion is also lower. This suggests that communication

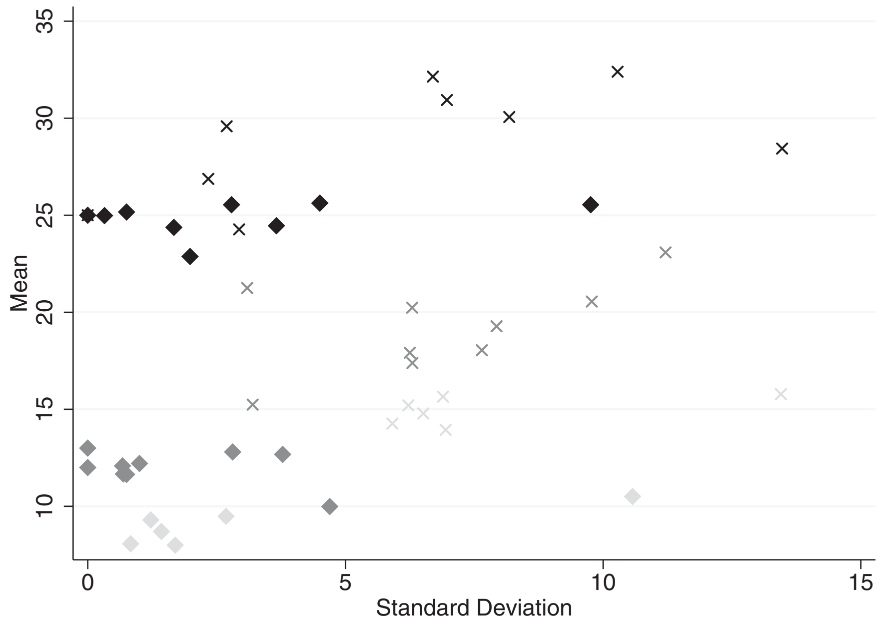

Figure 2. Mean and Standard Deviation of Quantities.
Notes: Observations of the No-Chat treatments are denoted by ×, and ◇ denote observations in the Chat treatments. Black symbols refers to $n = 2$, dark gray to $n = 4$ and light gray to $n = 6$.

allowed subjects to coordinate more easily on a vector of quantities, as opposed to the case where communication was not allowed.

Another metric of collusion is the rate at which firms were able to coordinate on the symmetric joint-profit maximizing output, see Table 4. Referring to this output as q_i^C and given the prediction is not always an integer, we define an outcome as perfectly collusive if all firms in a market post quantities within one unit of q_i^C, that is, $\lfloor q_i^C \rfloor \leq q_i \leq \lceil q_i^C \rceil \forall i$.[12] In the absence of communication, only duopolists managed to coordinate on the joint-profit maximum outcome, and even then, only about a quarter of the time. (This figure is very close to what Mermer, Mueller, and Suetens, 2016, observe for their strategic-substitutes duopolies). In the four-firm and six-firm markets, firms never achieved perfect collusion. In contrast, when communication was available, coordination on the joint profit maximizing quantity was much more frequent. The greatest coordination benefit from communication is drawn from four-firm markets.

Dynamics

We now examine how quantity choices changed over the course of the experiment. We begin by looking at whether or not individual players responded to quantities posted by other players in the previous round, and how communication affected this. To do this, we estimated the following Random Effects GLS model with robust standard errors, clustered at the market level.[13]

[12] Widening this interval by one unit does not change the qualitative pattern of results in terms of the relative gains from communication.
[13] The choice of the Random Effects estimator was driven by our use of time-invariant regressors.

Table 4. Absolute and Relative Frequency of Perfect Collusion

	$n=2$		$n=4$		$n=6$	
No-Chat	49	23%	0	0%	0	0%
Chat	137	63%	144	67%	71	49%
Gain	88	40%	144	67%	71	49%

$$q_{i,t}=\beta_0+\beta_1 Chat+\beta_2 Q_{-i,t-1}+\beta_3(Chat\times Q_{-i,t-1})+\beta_4 t+\beta_5(t\times Chat)+\varepsilon_{i,t}, \quad (2)$$

where $q_{i,t}$ is the output chosen by player i in round t of the experiment, *Chat* is a dummy variable for sessions in which communication was allowed between participants, $Q_{-i,t-1}$ is the total output selected by all other players in the market in round $t-1$.

Table 5 summarizes the estimation results. We provide estimation results for each treatment separately for ease of exposition. To test for treatment differences, we ran the same model estimation where all regressors were interacted with a set of treatment dummies. The results from that joint estimation can be found in Appendix Table A1.

We start by examining the restricted version of our model, in which we do not consider time trends (i.e., $\beta_4=\beta_5=0$). The coefficients on *Chat* in all three regressions confirm the analysis of Table 3: communication leads to lower average quantity. We do detect interesting differences in the three treatments with respect to how individuals reacted to aggregate quantities in the previous round. In the $n=2$ case, we observe a positive and highly significant coefficient on $Q_{-i,t-1}$, and a nonsignificant interaction of $Q_{-i,t-1}$ with *Chat*. Players therefore respond to higher quantity by their rival in the previous round with higher quantity in the present round, suggesting a collusive relationship over time between the two players, and one which does not require communication in order to be effective. In the $n=4$ case, that positive relationship is only present in the presence of communication, suggesting that collusion is perhaps harder to achieve in larger groups. Finally, in the $n=6$ case, we do not observe any relationship between $q_{i,t}$ and $Q_{-i,t-1}$ either in the presence or absence of communication.

Table 5. Random Effects GLS Estimates of Quantity

	$n=2$		$n=4$		$n=6$	
DV: $q_{i,t}$	(1)	(2)	(3)	(4)	(5)	(6)
Chat	−6.28*	−6.34*	−12.60***	−12.17***	−6.97***	−8.45***
	(3.37)	(3.62)	(2.88)	(2.69)	(2.41)	(2.32)
$Q_{-i,t-1}$	0.23***	0.23***	0.05	0.05	0.02	0.01
	(0.08)	(0.08)	(0.03)	(0.04)	(0.03)	(0.03)
$Chat\times Q_{-i,t-1}$	0.12	0.12	0.18***	0.17***	0.04	−0.04
	(0.11)	(0.11)	(0.06)	(0.05)	(0.03)	(0.03)
t		0.002		0.06		−0.06***
		(0.06)		(0.08)		(0.02)
$t\times Chat$		0.005		−0.02		0.10**
		(0.07)		(0.08)		(0.04)
Constant	22.29***	22.25***	16.35***	15.82***	13.45***	14.55***
	(2.67)	(2.77)	(2.40)	(2.32)	(2.31)	(2.26)
N	828	828	1656	1656	1656	1656
R^2	0.17	0.17	0.32	0.33	0.18	0.18

Notes: ***, **, *: respectively $p<0.01, p<0.05, p<0.10$.
Robust standard errors clustered at the market level in parentheses.

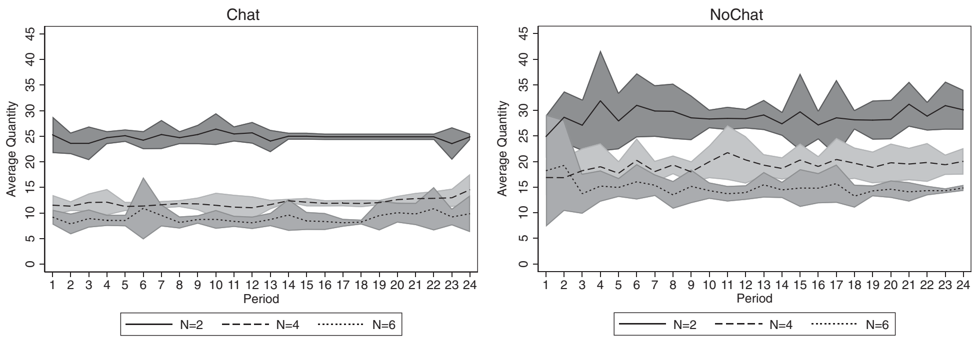

Figure 3. Time Series of Average Prices.
Notes: Solid lines denote estimated per round means, and dashed lines indicate 95% confidence intervals. Black, gray, and blue correspond to $n = 2, 4, 6$, respectively.

We next consider the unrestricted model in which we allow for the presence of time trends, both in the intercept and in its interaction with the *Chat* dummy, which capture the extent to which average quantity is allowed to vary over the course of the experiment in the two communication regimes. In the $n = 2$ and $n = 4$, the coefficients on these time trends are not statistically significant. This suggests that the relationship between $q_{i,t}$ and $Q_{-i,t-1}$ (if any) is relatively stable over time in both group sizes. The same is not the case for the $n = 6$: introducing the time trends increases the absolute size of the coefficient on *Chat*, which is now larger. We also observe a negative and significant time trend and a positive significant interaction with *Chat*; both are small in magnitude and seem to be dominated by the intercept effect. That is, the ability to communicate leads to a very large drop in output, which seems to increase slightly over time. This is congruent with the possibility that subjects were approaching the collusive output from below. In any event, players react to past changes in the aggregate output produced by other players in their market in the past round in a manner consistent with collusion.

As a caveat, we note that, due to the experimental design, we did not collect subjects' contemporaneous beliefs about the output choices made by the other firms in a given period. It is quite reasonable to expect that these beliefs would be an important determinant of quantity choices. If those beliefs are positively correlated with past choices, then we would expect the estimated coefficients on $Q_{-i,t-1}$ to be biased upwards because of omitted variable bias. In other words, our econometric results might be over-estimating the effect past choices by other firms have on current output choices.

Figure 3 illustrates the analysis presented so far. It shows the estimated per round average quantity for the six treatments. The left panel concerns the No-Chat treatments, while the right panel concerns the Chat conditions. Conditional on the communication regime, we observe clear mean differences across treatments, which remain constant over time. It is quite clear from the estimated 95% confidence intervals that there is much more variability in per-round output in the No-Chat treatments than in the Chat treatments.

The Gain from Communication

So far, what we found suggests (more or less) Nash-equilibrium play without communication and near-perfect symmetric collusion with chat. This was consistent with Hypotheses 1 (i) and 2 but not supporting Hypothesis 1 (ii).

Table 6. Random Effects GLS Estimates of Firm-Level and Market-Level Profits as a Function of Number of Firms

DV:	$\sum \pi_{i,t}$
n=2×*Chat*	167.58***
	(48.95)
$n = 4$	−716.28***
	(149.21)
n=4×*Chat*	840.61***
	(144.52)
$n = 6$	−1275.92***
	(90.75)
n=6×*Chat*	1307.74***
	(112.15)
Constant	2261.32***
	(48.57)
R^2	0.51
N	1,152

Notes: ***, **, *: $p < 0.01, p < 0.05, p < 0.10$.
Robust SEs clustered at the market level in parentheses.

We now put these findings together in terms of the gain from talking formalized in Hypothesis 3. Table 6 displays the estimation results of a simple treatment-effects interaction model with the per round industry profit $\sum_i \pi_{i,t}$ as the dependent variable. We estimate the model using Random Effects GLS with robust standard errors clustered at the market level. The difference in profits resulting from communication, ΔΠ, is reflected by the interaction terms $n \times$ *Chat*. This difference is higher in $n = 4$ than in $n = 2$ ($\chi^2(1)$=8.41, p=0.004). It is also higher in $n = 6$ than in $n = 4$ ($\chi^2(1)$=19.04, $p < 0.0001$). This is support for Hypothesis 3 which suggests that ΔΠ increases in n.[14]

Observation 3: The gain from communication, ΔΠ, (i) increases in n, and it does so (ii) at a decreasing rate.

It is informative to compare the results from this experiment to those of Fonseca and Normann (2012), who study the effect of communication in Bertrand markets in markets with two, four, six and eight firms. Unlike our article, Fonseca and Normann (2012) find an inverted-u relationship between the number of firms and the absolute gains from communication. The difference in results is a function of what firms do when communication is available. In the Bertrand environment without communication, average prices are collusive for $n = 2$ but they are very close to Nash for $n = 4$ and $n = 6$. We observe the same pattern in the Cournot environment. Communication was very effective in the Cournot markets irrespective of the number of firms, as the average posted quantity was very close to the joint profit maximizing level. In contrast, the Bertrand environment led cooperation to break down under communication as firm numbers increased. There are two possible reasons for this discrepancy in results. While the monopoly price in the Bertrand game studied by Fonseca and Normann (2012) was a natural focal point, any deviation by at least one firm led to all other firms earning zero profit for the period. In contrast, the quadratic profit

[14] Observation 3, which can be seen as our main result, is already reflected in average euro payments. When we calculate the difference in average profit per period per participant, explicit communication increased profit per period per participant by 0.04 euro in the $n = 2$ markets, by 0.21 euro in the $n = 4$ markets, and by 0.29 euro in the $n = 6$ markets, highlighting our conclusion that the gain from explicit collusion is increasing in n, but at a decreasing rate.

function in the Cournot game means that firms have a harder task to find the joint-profit maximum quantity from a cognitive perspective, but deviations from the collusive equilibrium are less punitive for the cheated firms.

Text-Mining Analysis of the Communication Data

In this section, we analyze the language used in the Chat variants in more detail. In particular, we wish to understand the extent to which the number of firms affects the language used, and what kind of language is useful to support collusion. To this effect, we employ *text mining* methods (Moellers, Normann, and Snyder, 2017).[15] Text-mining methods extract keywords from a body of text, referred to as a corpus. We will compare the most frequently used keywords for two corpora in order to find out how the corpora (the chats) differ. To be more precise, we will use Huerta's (2008) *relative rank difference* which tells us which keywords are comparatively more frequently used in corpus c relative to c'. Formally, we measure the keyness of word w in corpus c relative to c' by generating ranks $r_c(w)$ for all words w in corpus c according to frequency (and in descending order). The difference in the rank of w in corpus c relative to corpus c' is defined as

$$rd_c^{c'} = \frac{|r_{c'}(w) - r_c(w)|}{r_c(w)}. \tag{3}$$

As Huerta (2008, p. 967) points out, the *rd* score "denotes some sort of percent change in rank. This also means that this function is less sensitive to small changes in frequency in the case of frequent words and to small changes in rank in case of infrequent words." In other words, we are not concerned about cardinal measures, but ordinal measures, making the analysis distribution-free. This measure means that a unit change on the top of the ranking, say from first to second, will have a higher *rd* score than a change from 50th to 51st. This is intuitive because changes at the top of the ranking are more important than changes at the bottom of the ranking, since the former apply to very frequently used words, as opposed to the latter. Had we wanted to give changes a more equal weighting throughout the ranking, we would have raised the denominator to the power of larger than one. Also, a large *rd* score implies a large leap in the rankings from one corpus to the other, meaning that it is almost never used in one context to being very frequently used in the other.

In our analysis, we always compare the difference in the rank of w in corpus c relative to corpus c' and corpus c' relative to corpus c to get a complete picture. We restrict ourselves to keywords that are among the top 50 most common in corpus c, avoiding keywords with a high $rd_c^{c'}$ that are nevertheless rarely used. We omit conjunctions, prepositions, and articles and we only report keywords with $rd_c^{c'} > 1$.

Table 7 reveals some interesting insights into the differences in chat when it comes to the number of firms. It is instructive to look at the words that have the highest rank differential in the pairwise comparisons. In duopolies, "25" is discussed relatively more often than in the other market structures; "12" is relatively more frequent in four-firm markets; and "8" is relatively more frequently used in six-firm markets than elsewhere. This is hardly surprising: these numbers are the joint-profit maximizing outputs. It illustrates that subjects identified what the profit-maximizing output was, and attempted to coordinate on that value. The relatively high frequency of other close

[15] For alternative methods of text analysis, see Kimbrough et al. (2008) or Houser and Xiao (2011).

Table 7. Text-Mining Analysis

Two vs. Four				Two vs. Six				Four vs. Six			
$n = 2$		$n = 4$		$n = 2$		$n = 6$		$n = 4$		$n = 6$	
word	*rd*	word	*rd*	word	*rd*	word	*rd*	word	*rd*	word	*rd*
25	261.0	12	716.0	25	581.0	8	606.0	12	70.0	8	151.0
26	50.5	11	78.7	26	51.9	9	357.5	13	20.6	7	50.6
both	38.1	13	64.2	24	36.5	7	26.1	11	10.2	9	15.5
24	35.6	10	27.8	23	31.3	all	23.0	:)	4.0	B	4.9
27	27.4	9	20.7	27	28.1	B	22.1	20	3.9	5	3.2
23	21.7	everyone	11.0	both	15.4	10	22.0	oneself	3.1	one	3.0
50	16.5	15	4.9	I	5.0	A	16.9s	already	2.3	6	2.5
let	7.8	each	2.7	times	4.0	D	4.6	each	1.3	stay	2.2
I	5.0	works	2.0	50	3.8	5	3.1	times	1.1	do	2.1
think	3.8	gives	1.6	you	2.4	one	2.5			but	1.2
have	2.9	:)	1.5	let	2.4	do	1.8			A	1.1
stay	2.3	does	1.3	20	2.0	only	1.7				
you	2.1	how	1.1	think	1.8	to	1.4				
or	1.9			;)	1.7	still	1.1				
times	1.4			still	1.7						
but	1.1			better	1.5						
for	1.1			or	1.5						
	1.1			than	1.2						
	1.1			have	1.2						

We report words with absolute rank $r_c \leq 50$ and relative rank differential $rd \geq 1$

values could be an indication of learning or trial and error—recall that subjects did not have a payoff table. Furthermore, markets with $n = 4$ and $n = 6$ cannot produce the joint-profit maximizing aggregate output of 49 or 50 symmetrically. Hence, they also talk about targets other than “12” or “8.”

A conspicuous finding between duopolies on the one hand and the four- and six-firm treatments on the other is the relatively more frequent use of “both” for $n = 2$, and the relatively more frequent use of “everyone,” “one,” or “all” for $n = 4$ and $n = 6$.[16] These words were presumably used in the context of invoking a collective decision, or attempting to invoke a group identity. It is interesting to note that “I” and “you” were used more often in duopolies than in the other two treatments. This could signify that subjects may have attempted to coordinate on strategies that involved asymmetric output choices. In contrast, subjects the six-firm markets used capital letters (individual subjects were identified by capital letters on the screen) more. While duopolists may not have needed to use letters (hence their frequent usage of “you”), the use of letters in a large group indicates a particular individual was singled out by participants. One conjectures this was done as a reprimand for bad behavior in a previous round, or perhaps less likely, as a compliment for abiding to an agreement.

Another interesting target for language analysis is to compare groups that successfully colluded to groups that did not. A problem is that virtually all groups can be considered collusive. For example, 21 of 24 groups have an average quantity of plus 10% on top of the joint-profit maximizing output. And even the remaining three groups (all of which have $n = 6$) have average outputs closer to the joint profit maximum than to the static Nash equilibrium. The text-mining analysis still leads to some insights. We produce the comprehensive analysis in Appendix Table A2 and

[16] The “one” in the list of words refers to the German “einer,” as in “one of us.”

mention some conspicuous findings here. The successful groups (according to the above criterion), unsurprisingly, mention more frequently the collusive quantity targets "13," suitable for $n = 4$, and "25," suitable for $n = 2$. The three "unsuccessful" groups used relatively frequently nonsuitable (for $n = 6$) quantity targets like "7" or "10," and "please," indicating disagreement or uncertainty about choices.

In Appendix Table A3, we also provide a ranking of the words used most frequently in *absolute* terms. The table shows that, unsurprisingly, some words are frequently used throughout ("I," "ok"), but the quantities of the symmetric collusive outputs also appear at the top of the list. Since the collusive outputs differ across treatments, they have a particularly high *rd* score. For example, the quantity "12" is the most frequently used term with $n = 4$ but is never used with $n = 2$. These absolute frequencies imply a rather large relative rank difference of $rd_{n=4}^{n=2} = 716.0$. Intuitively, also more moderate differences in ranks can imply a substantial *rd* score when they score high in absolute frequency. "I" is the most frequent word with $n = 2$ and it is the sixth most frequent word with $n = 4$, suggesting $rd_{n=2}^{n=4} = 5.0$, that is, the relative rank difference is five.

6. Discussion

The main research question of this article is to quantify firms' additional profit from talking explicitly for Cournot oligopolies. We observe an increasing and concave relationship between the number of firms and this gain. In other words, markets with more firms find it more profitable to talk than markets with fewer firms.

Our finding is, on the one hand, consistent with the meta study of Balliet (2010). On the other hand, Fonseca and Normann (2012) found an inverse-u shaped relationship the authors should add between the number of firms and the incentive to collude. This shows that strategic substitutes vs. complements may matter (see also Mermer, Mueller, and Suetens 2016, for duopolies without talk) regarding the incentive to talk, as may asymmetries between firms (see Harrington, Hernan Gonzalez, and Kujal 2016). In any event, it cannot be taken for granted that the conventional wisdom—fewer firms find it easier to collude—reflects the gain from explicitly talking and therefore the frequency of cartels.

We furthermore find evidence confirming the role of communication as a catalyst to cooperation in repeated market games. Communication leads to a reduction in average quantities, and lower dispersion, suggesting that it facilitates coordination. The dynamics of output choices shows there are differences in the way communication helps collusion as the number of firms increases. In duopolies, the effect of communication primarily materializes through a level effect. We find dynamic output adjustments where firms positively respond to the quantity posted by the other firm in the previous period. Those adjustments are equal in magnitude in the Chat and No-Chat conditions. In contrast, the data from the four-firm markets shows dynamic quantity adjustments in the Chat conditions only. Coordinating on the profit maximizing output is a more difficult proposition when done by four firms, and communication appears to help. A still different pattern emerges in the six-firm markets. There, we find no dynamic output adjustments in response to other firms' behavior. Instead, we find a simple time trend effect, suggesting that communication only allowed subjects to recognize the advantages of lower quantities, while not allowing them to adjust outputs optimally—which is consistent with the observation that aggregate output in the six-firm markets with communication were substantially below the joint-profit maximum.

Appendix A: General Model

Underlying our design is a homogenous-good Cournot oligopoly with n firms as players. Firms choose quantities $q_i \in [0, \infty)$, $i=1, \ldots n$. Let $Q=\sum_i^n q_i$. Inverse demand is linear such that $p=\max\{a-Q, 0\}$, where p is the market price. Firms produce at constant marginal costs of c. Profits are denoted by $\Pi_i=(p-c)q_i$.

The two benchmarks we use are the static Nash equilibrium and the symmetric joint-profit maximum. In the static Nash equilibrium, each firm produces $q_i=(a-c)/(n+1)$ and earns a profit of

$$\left(\frac{a-c}{n+1}\right)^2. \tag{3}$$

For $n=1$, we obtain the monopoly output, $q_i=(a-c)/2$. The symmetric joint-profit maximum has therefore each of the n firms producing $q_i=(a-c)/2n$, yielding a profit for each firm equal to

$$\frac{(a-c)^2}{4n}. \tag{4}$$

We now show how the joint-profit maximum can be sustained as a subgame perfect Nash equilibrium (SGPNE) in a repeated game. Consider an infinitely repeated version of the above stage game. Firms discount future profits by a factor $\delta \in (0, 1)$. Suppose that firms aim at maintaining the symmetric joint payoff maximum as an SGPNE with a simple Nash trigger strategy. If firm i deviates, its best response is to produce $(a-c)(n+1)/4n$, yielding a defection profit of $((a-c)(n+1)/4n)^2$. For the symmetric joint payoff maximum to be an SGPNE, the stream of discounted collusive profits has to be at least as high as the profit from a one-time deviation followed by a grim (Nash) punishment path in the future, that is:

$$\frac{(a-c)^2}{(1-\delta)4n} \geq \frac{(a-c)^2(n+1)^2}{16n^2} + \frac{\delta(a-c)^2}{(1-\delta)(n+1)^2} \tag{5}$$

We can solve this inequality for δ. The discount factor has to be at least

$$\delta \geq \frac{(n+1)^2}{(n+1)^2+4n} \equiv \underline{\delta} \tag{6}$$

for cooperation to be a subgame perfect equilibrium.

We find $\partial\underline{\delta}/\partial n > 0$, so the minimum discount factor increases in n. The incentive constraint (Inequality 6) is a condition that necessarily has to be met in repeated games, regardless of whether players communicate explicitly. Furthermore, conditions like Inequality 6 are often interpreted as an indicator of how "difficult" collusion is. Thus, we have theoretical support for Hypothesis 1 in the main text. We note that Hypothesis 1 holds for other collusive equilibria with outputs below the joint-profit maximum. It also holds for other (more severe) punishment strategies.

Our Hypothesis 2 in the main text is based on experimental evidence and antitrust practice. It is not based on formal theory.

Hypothesis 3 is about the quantification of the gain from communication. We assume as an illustration that, without communication, firms earn static Nash profits as in Expression 3 whereas firms perfectly coordinate on the monopoly output when they are allowed to talk as in Expression 4. Thus, we have:

$$\pi_i^{No-Chat} = \left(\frac{a-c}{n+1}\right)^2 \tag{7}$$

and

$$\pi_i^{Chat} = \frac{(a-c)^2}{4n}. \tag{8}$$

Then, the gain from talking for this industry is:

$$\Delta\Pi = \frac{(a-c)^2}{4} - n\left(\frac{a-c}{n+1}\right)^2 = \frac{(a-c)^2}{4}\frac{(n-1)^2}{(n+1)^2}. \tag{9}$$

From $\partial\Delta\Pi/\partial n > 0$, this expression increases monotonically in n, and it approaches $(a-c)^2/4$—the maximum joint profit—for $n \to \infty$. In words, Equation 9 suggests that the gain from talking increases in n. Furthermore, $\partial^2\Delta\Pi/\partial n^2 < 0$. That is, $\Delta\Pi$ increases in n at a decreasing rate, as formalized in Hypothesis 3.

Appendix B: Instructions (Translated from the Original German Versions)

Duopolies No-Chat

Welcome to Our Experiment!

Please read these instructions carefully. If you have a question, please raise your hand and direct them at us. We ask you that you speak to your neighbors and that you keep quiet during the entire experiment! If you do not follow this rule, you may be excluded from the experiment and payment. In this experiment you will repeatedly make decisions that will earn you real money. How much you earn depends on your decisions and on the decisions of other participants. All decisions you make will be treated anonymously.

In this experiment you will represent a firm which produces and sells one and the same product, as does one other firm in the market. Both firms will always have to make one decision, namely to decide what quantity they wish to produce. The costs of production are 1 Taler per unit (this holds for all firms). Furthermore, your capacity allows you to have a maximum output of 100 units in each period. The following important rule holds: the larger the total quantity of both firms, the smaller the price in the market. More precisely, for each additional unit of output, the price will decrease by one Taler. Moreover, the price will be zero from a certain amount of total output upward. The price can be 100 Taler at most and cannot be smaller than zero.

Example 1: You and the other firm produce 40 units each, the total output is thus 80 units. This results in a price of 100 – 80 = 20 Taler and you get one profit of (20 – 1) * 40 = 760 Taler.

Example 2: You and the other firm produce 20 units each, the total output is thus 40 units. This results in a price of 100 – 40 = 60 Taler and you make a profit of (60 – 1) * 20 = 1180 Taler.

Note that you can also make losses. You will start with a starting capital of 16,000 Taler, which also serves as a show-up fee. After each round, you will be informed you of the amount the other participant has produced and how much your own profit is. At least 20 periods are played. Once the 20th period is over, the computer will decide with a virtual cube whether or not to continue. If a six comes up, the experiment is over. For any other number, the experiment will be continued.

You will be constantly matched with the same participant. At the end of the experiment, you will be told of your earnings in Taler which correspond to your payout. The following conversion rate applies: You will receive one euro for every 2,000 Taler.

Additional Instructions for Duopolies No-Chat

During the experiment, you will have the opportunity to communicate to the other firm in your market. In the first period, you will have one minute available for this; from period two and in all subsequent periods, 30 seconds will be available. For this purpose, you will have a chat-box on your screen which can be used to send and receive messages. Only the other person with whom you have been matched with can read your messages. You can send any number of messages. There are only two restrictions on messages: you must not identify yourself (via messages on age, gender, etc.) and you must not insult the other participants.

After one minute, or from the second period on after 30 seconds, the chat window will be closed and you must decide on the quantity you want to produce and sell in that period.

Appendix C: Additional Data Analysis

Appendix Table A1. Random Effects GLS Estimates

DV: $q_{i,t}$	(1)	(2)
Chat	−7.85***	−7.90**
	(2.96)	(3.14)
Chat×*n*=4	−7.07	−4.22
	(4.88)	(4.10)
Chat×*n*=6	0.83	−0.58
	(3.78)	(3.87)
$Q_{-i,t-1}$	0.17***	0.17***
	(0.06)	(0.06)
$Q_{-i,t-1}$×*n*=4	−0.14*	−0.12*
	(0.07)	(0.07)
$Q_{-i,t-1}$×*n*=6	−0.15**	−0.15**
	(0.06)	(0.06)
Chat×$Q_{-i,t-1}$	0.17*	0.17*
	(0.10)	(0.10)
Chat×$Q_{-i,t-1}$×*n*=4	0.03	−0.003
	(0.12)	(.12)
Chat×$Q_{-i,t-1}$×*n*=6	−0.13	−0.15**
	(0.11)	(0.06)
t		0.01
		(0.06)
t×*n*=4		0.05
		(0.10)
t×*n*=6		−0.07
		(0.07)
t × *Chat*		0.002
		(0.07)
t×*Chat*×*n*=4		−0.02
		(0.11)
t×*Chat*×*n*=6		0.10
		(0.08)
n = 4	−5.56	−8.43***
	(4.08)	(2.99)
n = 6	−10.70***	−9.58***
	(3.00)	(2.93)
Constant	24.19***	24.15***
	(1.98)	(1.93)
N	3772	
R^2	0.57	

Appendix Table A2. Text-Mining Analysis for Collusive versus Noncollusive Groups (The Latter Defined as Failing to Restrict Output Below the Joint-Profit Maximizing Level Plus 10%)

Collusive		Noncollusive	
word	*rd*	word	*rd*
13	21.8	7	22.3
25	16.3	please	6.8
you	7.7	5	3.9
20	6.7	6	2.9
11	5.8	10	1.7
I	4.0	still	1.6
still	3.4	9	1.5
does	2.8	15	1.4
12	2.2	was	1.1
and	2.1	us	1.0
:)	2.0		
times	1.4		
only	1.4		
if	1.1		

Notes: *The latter defined as failing to restrict output below the joint-profit maximizing level plus 10%.
We report words with absolute rank $r_c \leq 50$ and relative rank differential $rd \geq 1$.

Appendix Table A3. Ranking of Absolutely Most Frequently Observed Words in Each Treatment

$n = 2$	$n = 4$	$n = 6$
I	12	8
25	:)	9
ok	ok	ok
yes	10	all
:)	yes	10
we	I	I
times	we	yes
is	all	we
so	11	is
or	so	:)
not	13	not
still	is	7
more	and	and
and	not	so
then	too	now
what	then	do
too	times	also
also	it	what
you	now	but
but	still	it
;)	good	more
26	what	was
with	more	at
good	each	or
if	if	too
now	20	stay
stay	was	good
it	also	with
both	or	B
for	;)	further
24	still	still
was	as	even
one	9	then
better	with	one
23	continue	times

Acknowledgments

Comments of two anonymous referees greatly improved the article. We are also grateful to seminar participants at the Winter Seminar 2017 (Montafon) and EARIE 2017 (Maastricht) for useful suggestions.

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