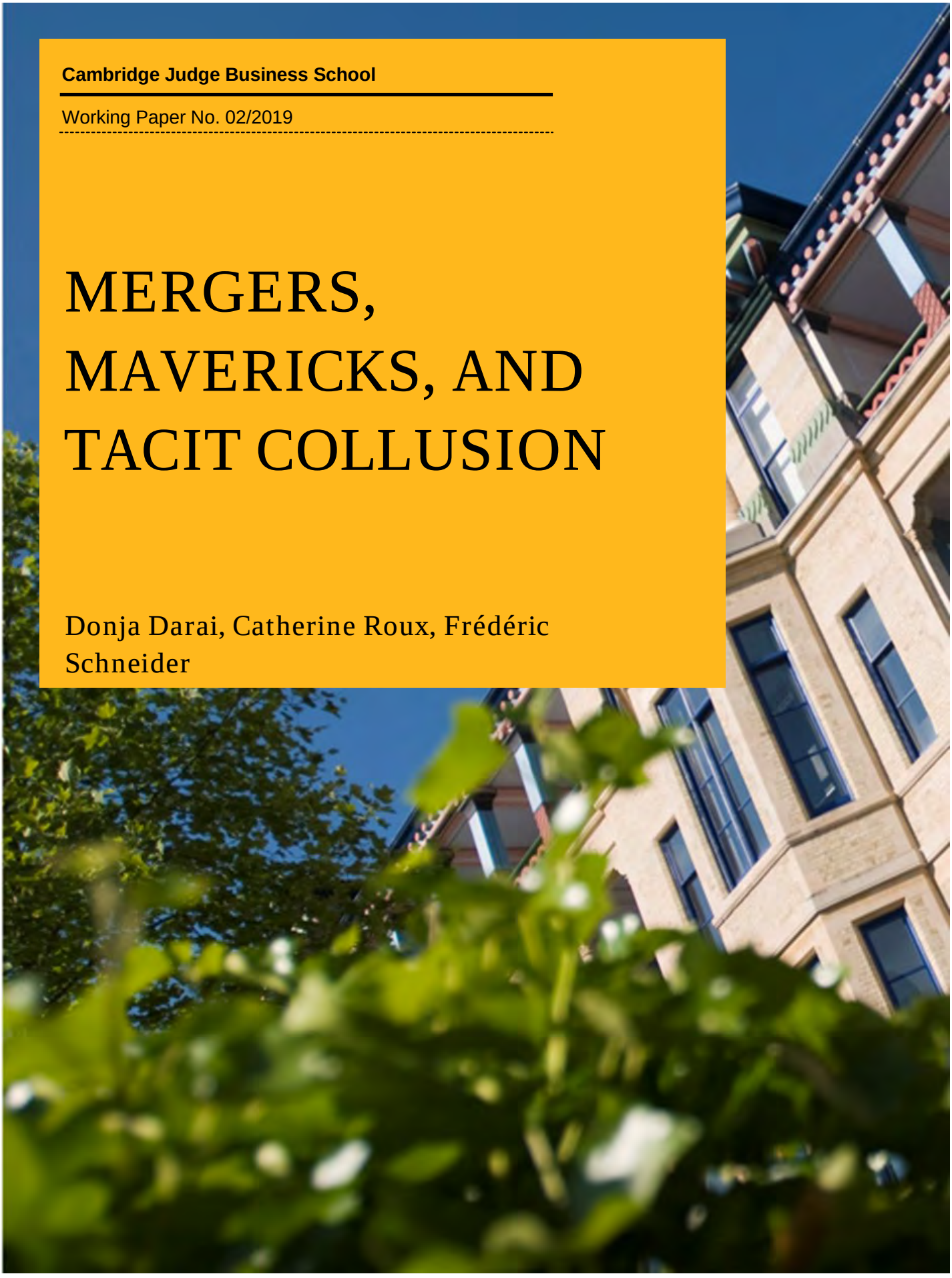

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Mergers, Mavericks, and Tacit Collusion*

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Abstract

We study whether firms' collusive ability influences their incentives to merge: when tacit collusion is unsuccessful, firms may merge to reduce competitive pressure. We run a series of Bertrand oligopoly experiments where the participants decide whether, when, and to whom they send merger bids. Our experimental design allows us to observe (i) when and to whom mergers are proposed, (ii) when and by whom merger offers are accepted, and (iii) the effect on prices when mergers occur in this way. Our findings suggest that firms send more merger offers when prices are closer to marginal costs. Maverick firms that cut prices and thereby fuel competition are the predominant (but reluctant) receivers of these offers.

JEL Classification: C91, D43, K21, L13, L41

Keywords: Mergers; Tacit collusion; Mavericks; Bertrand oligopoly; Experiments

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1 Introduction

Do collusive purposes motivate merger activity and if so, what role do mavericks play? In this paper, we study these questions in a laboratory experiment. Intuitively, firms' collusive ability may influence their incentives to merge because, when tacit collusion fails, firms may want to substitute it by horizontal mergers.[1] Our findings confirm this intuition to a great extent: firms tend to send more merger offers when the market price is close to marginal cost. Mavericks—firms whose aggressive price setting spurs competition in the pre-merger market—are the predominant receivers of these offers. However, as mavericks are particularly reluctant to merge, more frequent offers do not translate into increased merger activity in the markets that are relatively competitive.

1.1 Coordinated Effects

Coordinated effects long have been central to U.S. merger policy.[2] A merger exhibits coordinated effects if it enhances the scope for tacit collusion in the post-merger market. In a well-known hospital merger that was challenged by the Federal Trade Commission on the grounds of coordinated effects, Judge Richard Posner stated that "the ultimate issue" in reviewing a merger under the antitrust laws "is whether the challenged acquisition is likely to hurt consumers, as by making it easier for the firms in the market to collude, expressly or tacitly, and thereby force price above or farther above the competitive level."[3]

One way a merger may help collusion is by reducing the number of independent decision makers. The structural presumption that high market concentration facilitates collusion enjoys vast theoretical and experimental support in economics.[4]

[1] In Stigler's words: "Collusion of firms can take many forms, of which the most comprehensive is outright merger" (Stigler, 1964, p.45).

[2] See, e.g., Kolasky (2002). More recently, coordinated effects also have received increased attention in economic theory, e.g., in Compte et al. (2002); Kühn (2004); Vasconcelos (2005).

[3] Hospital Corporation of America v. Federal Trade Commission, 807F.2d 1381 at 7 and 8 (7th Cir. 1986), quoted in Baker (2003, p.31).

[4] Real-world evidence is less clear: while empirical studies suggest that the median number of cartel members lies between six and ten (Posner, 1970; Hay and Kelley, 1974; Fraas and Greer, 1977), anecdotal evidence indicates that cartels with more than a dozen members are common (e.g., cartels in prestressing steel with 17 and in copper fittings with 30 companies (EC IP/11/403 and EC IP/06/1222). Even tacit collusive agreements with a large number of firms appear to be

The experimental literature examines static oligopoly games with varying numbers of symmetric firms (see, e.g., Dufwenberg and Gneezy (2000); Isaac and Reynolds (2002); Huck et al. (2004); Fonseca and Normann (2008, 2012); Roux and Thöni (2015)) and uses comparative statics of market structures to study the impact of concentration on competition. With larger numbers of players corresponding to pre-merger and smaller numbers to post-merger situations, this literature can shed light on whether mergers increase a market's collusive potential. The findings suggest that reductions from four to three as well as from three to two symmetric firms have substantial price effects (Huck et al., 2004; Horstmann et al., 2018).[5]

Existing experiments have left the question of who should be allowed to merge with whom for some given initial concentration level largely unexplored (Goette and Schmutzler, 2009). Two notable exceptions are Davis and Holt (1994) and Fonseca and Normann (2008). Both deal with firm asymmetries.

Davis and Holt (1994) consider an experimental Cournot market in which firms differ in capacities, namely, three firms with larger and two firms with smaller capacities. They compare the price effects of two changes in market structure: first, a shift to a market with two even larger firms and three small firms, and, second, a shift to a market with three large firms. The price effect from the first change turns out to be greater than the effect from the second change. This finding is consistent with the common policy practice of taking a more hostile view towards mergers involving leaders than towards mergers involving laggards (Goette and Schmutzler, 2009).

Fonseca and Normann (2008) study experimental oligopoly markets which differ either in firm numbers (two and three) or in capacity allocation (symmetric and asymmetric) or in both. They show that an increase in market concentration affects the market price differently depending on whether the increase is due to a reduction in firm number or to an asymmetric capacity distribution. The authors argue that, since a real-world merger typically affects both—firm number and capacity distribution—competition agencies should be careful in drawing policy conclusions

sustainable. In 1994, for example, about 60 independent NASDAQ market makers systematically followed an implicit collusive scheme when quoting several actively traded stocks (Christie and Schultz, 1994, 1995).

[5]In line with this, the European Commission's merger decisions published from 1990 to 2004 indicate that the Commission sees potential for coordinated effects only if the post-merger market would include two remaining firms with fairly identical market shares (Davies et al., 2011).

for merger analysis based solely on concentration measures.

1.2 Mavericks

In recent years, antitrust scholars have devoted increasing attention to the role of mavericks in destabilizing collusive agreements. A maverick is a firm that declines to follow the industry consensus and plays an unusually disruptive and competitive role in the market. The existence of a maverick therefore constrains the firms' ability to collude. Firms may differ in their willingness and capacity to adhere to collusive schemes and thus some firms may be more inclined to act as a maverick than others (because of, e.g., low discount factors (Jayaratne and Ordover, 2014), low costs (Owings, 2013), excess capacity, and particularly competitive business models (Breunig and Menezes, 2008)). An illustrative example of a maverick is Northwest in February and March 2000, when the major U.S. passenger air carriers attempted to implement ticket fare increases in the U.S. passenger airline market (Baker, 2002).[6] Northwest successfully smashed two initiatives by Continental Airlines to achieve price raises between twenty and forty dollars per round trip. All the airlines that had promptly matched Continental's price increases—American, Delta, TWA, United, and US Airways—rolled back after it became apparent that Northwest would not follow suit.[7]

Antitrust authorities all over the world give a prominent role to mavericks in their merger review processes.[8] The U.S. Department of Justice (DOJ) as well as the European Commission (EC) have repeatedly opposed mergers on the grounds that these would remove a particularly aggressive competitor from the market which "may make coordinated interaction more likely, more successful, or more complete" (U.S. 1992 Horizontal Merger Guidelines, p.20).[9] Accordingly, the DOJ challenged

[6]Similar examples arise in other contexts: see Breunig and Menezes (2008) for mortgage providers in Australia and Eckert and West (2004a,b) for retail gasoline in Canada.

[7]When, some days later, Northwest reversed course and raised its prices similar in dollar magnitude to Continental's earlier proposals, the price raise was quickly matched by all big airlines and was not rescinded.

[8]E.g., Horizontal Merger Guidelines, 2010 (e.g. page 3) for the U.S., Guidelines for the assessment of horizontal mergers, 2004, (e.g. section 20d) for the EU, Mergers and Acquisitions Guidelines, 2013 (e.g. section 3.87) for New Zealand, Merger Guidelines, 2008 (e.g. section 7.56) for Australia.

[9]The U.S. DOJ opposed the acquisition of T-Mobile by AT&T "as an independent, low-priced rival [which] would remove a significant competitive force from the market" (Case No. 1:11CV01560,

the proposed Continental/Northwest alliance, and the parties agreed to abandon the project shortly after the trial began.

Despite the competition authorities' reliance on the 'maverick theory' in challenging mergers, the economic literature on mavericks is small: we are aware of only one theoretical and one experimental study on the role of mavericks in mergers. Kwoka (1989) shows that a merger in a Cournot industry is more likely to be profitable if it absorbs a particularly tough competitor because this results in a stronger contraction of industry output and in higher prices than the absorption of a less aggressive competitor. Engel and Ockenfels (2014) observe that entry in an experimental Cournot market by a maverick strengthens competition and lowers incumbents' profits. Still, mavericks are not prime candidates for buyouts in their experiment. A possible explanation for the incumbents' reluctance to buy out aggressive entrants may be that one incumbent alone pays for the maverick leaving the market, but everyone profits from this. If incumbents care about social comparison, they may not want to put themselves in a disadvantageous profit situation and thus, they reject the buyout possibility.[10]

1.3 Our Study

In this paper, we introduce a novel experimental design to investigate the coordinated effects of mergers in Bertrand oligopoly markets with repeated interaction. We study how individual market players affect the competitive dynamic and how their elimination through a merger may impact the likelihood of collusion. We focus on firms' decisions whether or not to merge in a setting where we allow the market

para. 3, 2011). Likewise, the DOJ blocked the proposed acquisition by H&R Block Inc. of TaxAct since "by taking control of the TaxACT business, which has been a maverick in the market, it would be easier for H&R Block to coordinate on prices, quality, and other business decisions with the other remaining industry leader[...]" (Press Release 11-661, May 23, 2011). It is noteworthy that in both of these proposed mergers the acquiring firm was the second largest in the industry. Thus, if the DOJ had neglected the maverick argument, the mergers could have been seen as enhancing competition by making the second-place firm more capable of competing against the first-place firm (Owings, 2013). In a recent case, the EC has taken a similar stance by expressing concerns that the proposed transaction would remove a key competitor from the market of industrial packaging and thereby raise prices for consumers (Case M.7566, O.J. C430/2015).

[10]Another experimental study which may be seen as related is Li and Plott (2009). In an environment conducive to tacit collusion, they study bidder behavior in auctions. They show that the tacit collusive equilibrium establishes quickly and persistently and can only be disrupted by competitive entry.

structure to evolve dynamically and endogenously.

The previous experimental literature takes either a static (between subjects) approach which compares oligopoly markets with different firm numbers (see the studies on static oligopoly games cited above) or a dynamic (within subjects) approach in which the experimenters exogenously impose whether, when, and between whom the consolidations take place (see, e.g., Huck et al. (2007), Davis and Holt (1994) and Davis and Wilson (2000)). Our experimental design is fundamentally different: we allow subjects to decide freely not only whether and to whom they send merger bids but also when to issue these bids within four predefined merger phases. During these phases they have the possibility to make takeover proposals to the other market participants. In between each merger phase, the players compete in prices within the new market structure. The reason why we study a dynamic and endogenous structure is to understand the firms' motives behind merger decisions. Our experimental design allows us to observe (i) when and to whom mergers are proposed, (ii) when and by whom merger offers are accepted, and (iii) the effect on prices when mergers take place.

In terms of structure, our experiment is closest to Croson et al. (2004), Lindqvist and Stennek (2005), and Engel and Ockenfels (2014) as they all analyze endogenous merger formation in a dynamic setting. The focus of the former two studies, however, is different from ours. Croson et al. (2004) emphasize the bargaining process that leads to different coalitions and Lindqvist and Stennek (2005) test the 'insiders' dilemma'.[11] Moreover, they do not examine mavericks. Engel and Ockenfels (2014) are mainly interested in the heterogeneity in people's social preferences and whether maverick behavior can be explained by a rivalistic social value orientation. We do not make the link between social preferences and market competition and identify mavericks solely by their price setting behavior in our experimental markets.

Our main motivation to use experimental methods is that it is difficult to get insights into our research question with field data. The reasons for this are threefold: first, many different intervening structural factors surrounding a merger such as economic conditions, efficiency gains, and productive capacities may affect post-merger pricing decisions of both the merged entity and its competitors. In the

[11] The insiders' dilemma is the phenomenon that a profitable merger may not form because firms prefer to stay outside a merger that raises the market price (Salant et al., 1983).

laboratory, we can exclude these influences and isolate the effect of strategic aspects of mergers on firms' pricing decisions.

Second, studying coordinated effects in the field requires identifying tacitly collusive situations. By tacit collusion, economists mean a situation in which prices are higher than some competitive benchmark (Motta, 2004). An obvious candidate for such a benchmark is marginal cost. While price data are widely available, data on marginal costs are usually difficult to get.[12]

Finally, it is difficult or even impossible to collect and interpret data on the counterfactual, namely, mergers that did *not* occur (because they were blocked). Exactly this evidence, however, is crucial to study coordinated effects in the aftermath of mergers that rise competitive concerns. Running a laboratory experiment overcomes all of these difficulties and the purpose of this paper is to study the role of mavericks for a market's collusive potential in such an experiment.

We have four main results. First, we find strong evidence for coordinated effects of mergers. Prices exceed marginal costs in the post-merger market and, in line with existing experimental evidence, we find support for the common wisdom that they increase with market concentration. Second, we find that the lower the market prices on pre-merger markets, the higher the activity in the merger phase: firms tend to send more merger offers. This finding is novel for oligopoly experiments, and it suggests that mergers may serve a collusive purpose. Third, our data confirms that the industry maverick, that is, the market player with the lowest price in the pre-merger market, is the predominant receiver of these offers. Fourth, mavericks are reluctant to agree to mergers. Overall, our findings give support to the current merger policy with its emphasis on the elimination of a maverick as a collusion-facilitating device.[13]

The remainder of this paper is organized as follows. Section 2 describes the experimental design. Section 3 explains the hypotheses. Section 4 discusses our results, and section 5 concludes.

[12]There are other screening methods to detect collusion that are not based on price-cost margins. But the goal of those screens is typically to detect cartels, that is, explicit and not tacit collusion (Harrington, 2008).

[13]Such support is important in practice: antitrust authorities have been criticized for their focus on mavericks, mainly due to the lack of an economic basis for these considerations (see page 3 and footnote 6 in Engel and Ockenfels (2014)).

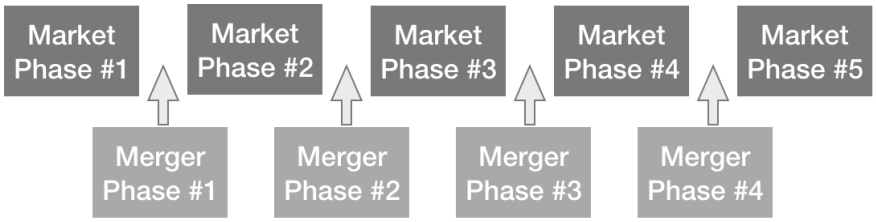

Figure 1: Five market phases intermitted by four merger phases

2 Experimental Design and Procedures

We designed a novel experiment that combines standard multi-period, dynamic oligopoly games with intermittent opportunities for the market participants to merge. Initially, each subject owns one firm and engages with three other firm owners in a Bertrand price competition. In total, subjects play 50 periods of the Bertrand game.[14] These periods are grouped into five market phases of 10 periods each. In between two market phases, a merger phase provides subjects with the opportunity to acquire other subjects' firms. Thus, the number of active market participants can decrease over time, potentially up to a monopoly with just one subject owning all four firms. Figure 1 shows the different phases of the experiment. In the following, we first describe the market phases, then the merger phases, and finally present all treatment variations.

2.1 The Market Phase

At the beginning of the first market phase there are four active firms in the market. Firms are identical: each produces a homogenous good at zero cost, without capacity constraints. In any given period, each participant simultaneously posts a price she demands for a unit of the good. Prices are integers from 0 to 100 experimental

[14] We chose to implement the experiment as a finitely repeated game mainly because of simplicity. Theoretical models of collusion use infinite repetition which would be simulated in the experiment by having a random continuation rule. In practice, however, subjects behave as if the time horizon was infinite if the time horizon is long enough (Selten and Stoecker, 1986; Normann and Wallace, 2012).

currency units (ECUs).[15] The demand side consists of 300 (computer-simulated) buyers, each of whom buys exactly one unit of the good at the lowest posted price (the market price). If more than one firm posts the lowest price in the market, consumers are evenly split among these firms. Firms that post higher prices do not attract any consumers.

Denote the price posted by firm i as p_i, the minimum of the posted prices as p_{min}, and the number of firms posting this minimum price by N_{min}. Then, the period-profit of firm i is

$$\pi_i = \begin{cases} \frac{300}{N_{min}} p_{min}, & \text{for } p_i = p_{min} \\ 0, & \text{else.} \end{cases}$$

We use this simple market form to be able to conduct a clean test of our hypothesis that mergers facilitate collusion. In particular, we can rule out production costs and capacity constraints as a motive for merging. Finally, our design removes the insiders' dilemma inherent in Cournot markets.

2.2 The Merger Phase

After market periods 10, 20, 30, and 40, respectively, active market participants have the opportunity to acquire other firms within their respective market.

Before participants can make merger offers to another firm, they see a review screen of the previous market phase. That screen shows posted prices, market prices, and profits over time during the preceding market phase so that participants can make an informed decision. In the next step, all active market participants can post targeted offers to acquire another firm within their market. All offers are displayed in real time. An offer does not consist of a payment but of the right to an equal share of the future profits of the combined entity. If the participant who owns the target firm agrees to the merger, it is successful. Each participant can only engage in one merger (either as acquisitor or as target) per merger phase. After two minutes, the merger phase terminates and the following market phase ensues with the remaining active participants in control of the firms.

[15] ECUs were converted into Swiss Francs (CHF) at the end of the experiment. 5000 ECU equals 1 CHF.

Mergers take a specific form in our experiment. Suppose participant i acquires participant j's firm. Then participant j becomes inactive for the remaining periods of the experiment. The two firms remain separate but participant i now has the power to post prices for both firms. Mergers are costless for the acquisitor but profits from the two firms in all future periods are split equally between the two participants. Mergers are cumulative over time: if participant i acquires participant j's firm in the first merger phase, and participant k then acquires the combined firms from i in the second merger phase, k then controls all three firms (i.e., posts the prices for these firms), and the subsequent combined profits from the firms are split equally among the three participants.

While this design restricts the modalities of acquisitions, it keeps the merger phase simple. It allows us to overcome potential differences in participants' bargaining skills and in their beliefs about future profits as participants do not need to calculate potential future profits and explicitly state an acquisition price.

2.3 Treatment Variations

We also conducted three variations of the above baseline design, which we refer to as MERGER. The main variation, NOMERGER, is identical to MERGER, but without the intermittent merger phases. Since participants have no opportunity to acquire other firms, all market periods feature four active firms. We use this condition to assess the effect of mergers on market prices.

In addition, we designed two variations to reduce the attractiveness of mergers. In the COMMUNICATION condition, we allowed free-form communication between participants before each market period. Before the active participants post their prices for the period, they could write chat messages that were publicly displayed. In periods 1 and 2 of each market phase, the chat window stayed open for 60 seconds; in periods 3 to 10 of a market phase, the chat period was shortened to 30 seconds. We implemented this condition because it is the literature finds that communication facilitates collusion (Andersson and Wengström, 2007; Fonseca and Normann, 2012, 2014; Cooper and Kühn, 2014; Harrington et al., 2016). Communication would thus decrease the need for mergers if mergers have a collusive purpose.

In the last variation (DUOPOLY), the formation of a monopoly was forbidden.

That is, mergers were allowed but, in all market phases, there were at least two firms. We conjectured that, because participants could not exploit the full potential of market concentration, this variation would decrease the usefulness of mergers. We briefly discuss the results of COMMUNICATION and DUOPOLY in Section 4.3.

2.4 Procedures

We conducted the experiment at the Economics Department of the University of Zurich in June 2014. It was programmed and run in z-Tree (Fischbacher, 2007). A total of 148 subjects participated in 5 sessions of the experiment (2 sessions with 32 participants each for MERGER, 1 session with 28 participants for each of the other treatments). Only one treatment was run in any particular session, and no subject participated in more than one session (between-subjects design). Participants were randomly assigned to treatments as well as randomly sorted into markets of four, and remained in the same market for the entire experiment. We provided written instructions which informed the subjects of all the features of the market and of the different phases (for the detailed instructions see the appendix). Sessions lasted about 2 hours and subjects received an average payment of 55 CHF (∼56 USD, 20 CHF show-up payment plus their cumulated earnings from the experiment).

3 Hypotheses

We begin with the conventional wisdom that collusion is easier with fewer firms (Chamberlin, 1933; Bain, 1951; Stigler, 1964). Previous experiments have already confirmed this conventional wisdom (although in different settings) which, in our case, could be straightforwardly formalized in an infinitely repeated game with trigger strategies (Tirole, 1989; Ivaldi et al., 2003; Motta, 2004).[16] In our MERGER condition, we thus expect to replicate the results from the literature (e.g., Fonseca and Normann (2012)) and, we put forward the following hypothesis.

[16]Cooperation in finitely repeated games is usually modeled using a "gang of four" type model (Kreps et al., 1982). Empirically, too, a finite horizon does not significantly lower average cooperation rates in experimental prisoner's dilemmas (Normann and Wallace, 2012). However, endgame effects are common in the last couple of rounds.

Hypothesis 1. *With the possibility to merge, market prices will increase with fewer firms.*

Next, we consider the motive behind merger offers. A prominent argument for why firms may want to merge is to soften price competition (Scherer, 1980; Evenett et al., 2001). For example, Bittlingmayer (1985) and Lamoreaux (1988) argue that the passing of the Sherman Act in 1890—which outlawed collusive pricing but not merger activity—led firms who wished to coordinate prices to switch to mergers instead.[17] The Clayton Act of 1914 was introduced to extend antitrust legislation to anticompetitive mergers (Motta, 2004). Since our structurally symmetric Bertrand oligopolists have no reason to merge other than the coordination on prices above costs, we expect that the more competitive the pre-merger market, the more firms want to merge.

Hypothesis 2. *With the possibility to merge, the attractiveness of a merger increases with a lower pre-merger market price.*

Finally, we explore the question whether one way to achieve softer price competition is to buy out a tough competitor. In line with the legal literature on coordinated effects and on the role of mavericks in merger review processes, we expect that firms with lower prices in the pre-merger market are the predominant receivers of the merger offers during the merger phases.

Hypothesis 3. *With the possibility to merge, the more aggressive the pre-merger price setting of a particular firm, the more likely it will be the receiver of a merger offer during the ensuing merger phase.*

4 Results

In the following, we discuss our experimental results in the order of the hypotheses. All reported regression models are OLS, with standard errors adjusted for clustering at the market level.

[17] The literature on the formation of research joint ventures for a collusive purpose is related to this argument. See, e.g., Helland and Sovinsky (2019) for an empirical examination of whether research joint ventures may facilitate collusion.

4.1 Coordinated Effects

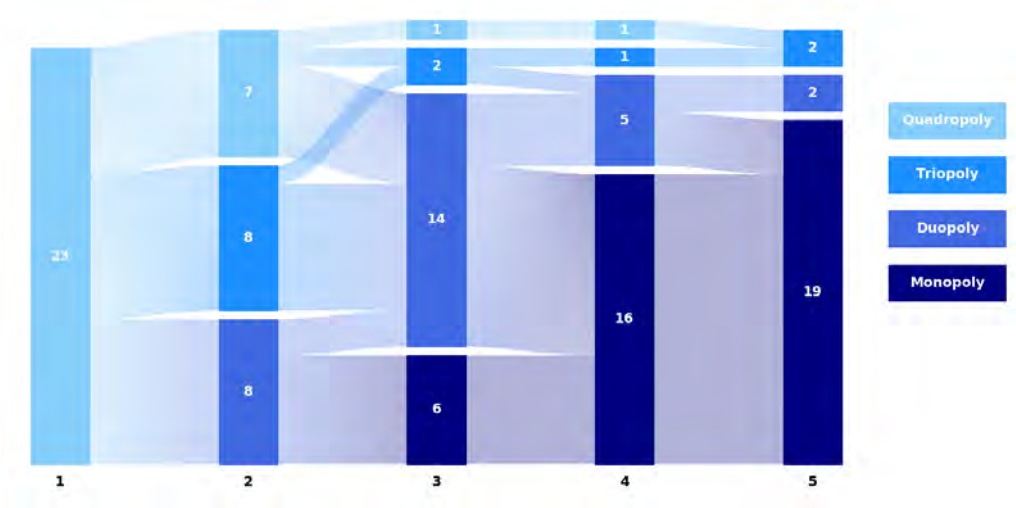

Figure 2: Number of quadro-, trio, duo-, and monopolies by Market Phase (MERGER Treatment)

We start with the analysis of our experiment by showing that mergers occur and that they have coordinated effects. Figure 2 displays the number of markets by market size, across the five different market phases in the MERGER treatment. By design, all markets start out with four firms in phase 1. After the first round of mergers, only 7 markets have not had any mergers while 8 markets have already achieved two mergers and have proceeded to a duopoly. In phase 3, the first 6 markets are already monopolies. By phase 4, we have 16 monopolies, and in the final phase, all markets have concentrated to some degree and 19 out of 23 markets or 83 percent are monopolies.

Figure 3 shows average market prices for the different market concentration levels in MERGER compared to the average market price in NOMERGER. While average market prices start on the same level in MERGER and NOMERGER, they substantially rise in duopolies. Prices are lowest, on average, in quadropolies (23 ECU) and triopolies (11 ECU), are intermediate in duopolies (44 ECU) and highest in monopolies (99 ECU).[18] An alternative indicator for improved coordination in

[18]Our finding that triopolies seem somewhat less collusive than quadropolies is a bit puzzling, but also, e.g., Dufwenberg and Gneezy (2000) find a slight price increase from triopoly to quadropoly.

more concentrated markets is the average spread of posted prices. Appendix 5 shows that the latter monotonically increases as the number of firms increases.

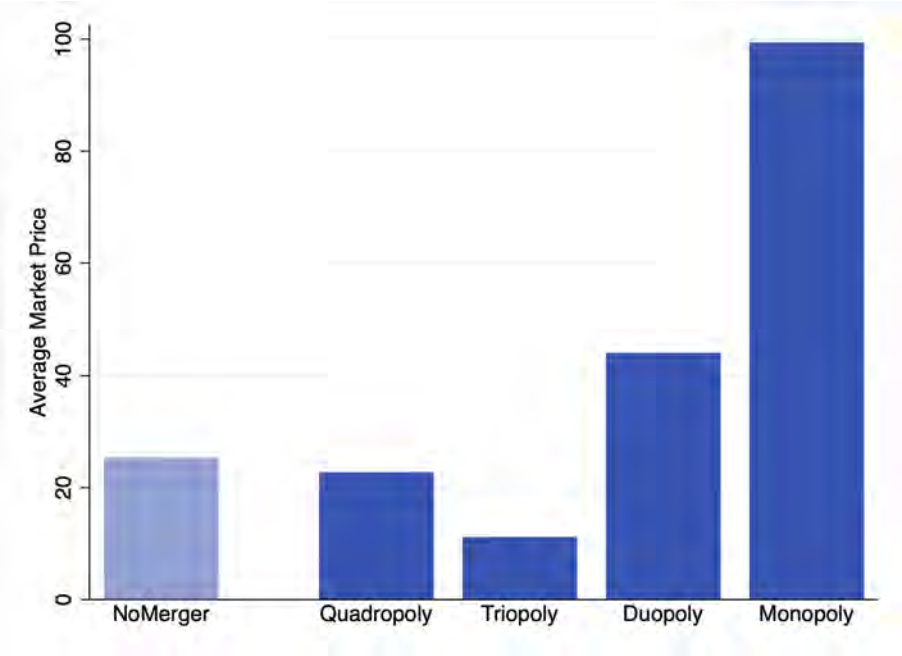

Figure 3: Average Market Prices in the MERGER and NOMERGER Treatments

Table 1 shows the corresponding regressions, using only data from the MERGER treatment.

Model (1) only includes dummies for number of competitors in the market, while Model (2) also includes period dummies. The results confirm the visual impression: concentration leads to higher prices, but only monopolies lead to substantial gains and significantly increased prices. As suggested in Figure 3, we find a weakly significant *decrease* in market prices for triopolies, and duopolies do not significantly increase market prices once we adjust for period fixed effects.[19]

Result 1. *Market prices exceed marginal cost and, with the possibility to merge, they increase with fewer firms.*

[19]Since market size is fixed to four firms in the beginning and can only decrease over time, the two variables are mechanically correlated.

Table 1: Regression Analysis of Market Price Levels

Dep. Variable	Market Price	
	(1)	(2)
3 Firms	-11.530**	-31.364*
	(5.810)	(16.497)
2 Firms	21.33**	1.013
	(10.494)	(22.947)
1 Firm	76.682***	55.821**
	(8.308)	(25.613)
Period Dummies?	No	Yes
Constant	22.738***	19.174***
	(8.308)	(2.338)
R-squared	0.664	0.694
N	1150	1150
Clusters	23	23

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2 Merger Offers

As we have seen above, while prices are above marginal cost, there is ample room for higher prices. By definition, collusion fails when there is at least one maverick to undercut the other firms' posted price. Mergers can then be used to eliminate the mavericks and subsequently increase the market price. We now concentrate on the MERGER treatment and investigate whether we can see such behavior in our data.

Table 2 presents OLS regression results from the merger phases. In Model (1), we regress the number of merger offers per group and merger phase on a number of indicators of the market environment in the preceding market phase: average market price, average maximum posted price, the linear price trend over the 10 market periods, price volatility around the linear trend, and the spread of average profits across firms. We also include dummies for market size (omitted category: 4 firms) and for the market phase.

We observe that there are more merger offers in markets with lower average market price, and in markets with higher *maximum* posted price. That is, more offers are made when there is a larger discrepancy between the actual market price

Table 2: Regression Analysis of Offers Made and Accepted during Merger Phases

	(1)	(2)	(3)	(4)
Market Price	-0.112***	0.001	-0.038***	0.004*
	(0.027)	(0.003)	(0.008)	(0.002)
Max. posted Price	0.112***	0.000	0.037***	-0.004***
	(0.025)	(0.002)	(0.008)	(0.001)
Price Trend	-0.019	-0.013	-0.013	-0.002
	(0.122)	(0.017)	(0.037)	(0.009)
Price Volatility	-0.036	-0.017**	-0.003	-0.008**
	(0.069)	(0.008)	(0.020)	(0.003)
Profit Spread	-0.027	0.010	-0.037	0.035
	(0.197)	(0.045)	(0.075)	(0.034)
# Firms = 3	-1.799	-0.257	-0.125	-0.203**
	(1.955)	(0.229)	(0.589)	(0.098)
# Firms = 2	-2.732*	-0.041	-0.375	-0.008
	(1.381)	(0.239)	(0.324)	(0.155)
Phase 2	-0.402	0.239	0.004	0.152
	(1.491)	(0.179)	(0.389)	(0.092)
Phase 3	-1.494	-0.008	-0.323	0.119
	(1.621)	(0.247)	(0.464)	(0.139)
Phase 4	-2.428	-0.063	-0.600	0.081
	(1.833)	(0.252)	(0.527)	(0.170)
Δ Profit			0.012	-0.107***
			(0.065)	(0.038)
Δ Price			-0.019**	0.003
			(0.008)	(0.002)
Constant	3.655***	0.849***	0.823**	0.475***
	(1.224)	(0.135)	(0.316)	(0.070)
R-squared	0.423	0.008	0.207	0.079
N	70	70	215	175

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

and the price that unsuccessful firms would have liked to realize.[20]

Result 2. *Merger offers are more likely in markets that are more competitive and that show a higher discrepancy between actual market price and highest posted price.*

While firms show more interest in merging in markets that are more competitive, they also struggle to realize those proposed mergers. We find some indication that not only offers to merge but also actual mergers occur more when pricing is less collusive: when we divide quadropolies in those that will merge in the next merger phase and those that do not, the ones that will concentrate have less than half the average market price than those that will not (17.5 versus 36.2). This difference is, however, not significant.[21]

Model (2) regresses the number of *actual* mergers on the same set of independent variables as in Model (1). In contrast to the first model, the indicators of firm behavior have no predictive power on mergers. In other words, while there are more *offers* in markets with lower prices and higher maximum posted prices, there are not more *mergers*. One reason could be that these markets are precisely those where collusion fails due to mavericks, and mavericks may both receive more offers from non-mavericks but also refuse offers extended to them, thus nixing the overall effect.

We test this conjecture in Models (3) and (4), where we analyze behavior at the firm level. In Model (3), we regress the number of offers received by firm i in group g during merger phase t. We include the same market-level variables as in the two previous models and add two firm-level variables, one for profitability (deviation from average market profit, Δ Profit) and one for price undercutting (deviation from average posted price, Δ Price). The second variable is our definition of a maverick: the average amount by which firm i's posted price exceeds or undercuts the other market participants. We find that mavericks do indeed receive significantly more offers, as the negative coefficient on price deviation indicates.

Conditioning on having received an offer, Model (4) regresses whether firm i accepts an offer. We include the same independent variables as in Model (3). We

[20] In addition, the number of offers decreases with the number of remaining firms, as fewer active owners remain to make and receive offers. With four active owners, there are 12 possible distinct offers but only two when only two active participants remain.

[21] t-test, $N = 32$, $p = 0.167$.

see that firms are less likely to accept an offer the more profitable they are compared to their competitors. Thus, the prospect of having to share profits with a co-owner seems to outweigh mavericks' prospects of higher post-merger prices. Price undercutting is, *ceteris paribus*, not related to accepting an offer.

We also observe a reversal of the coefficients on the two main group-level variables, average market price and maximum posted price. That is, firms are more inclined to accept a merger offer in markets where the average market price is *higher* and the discrepancy between market price and maximum posted price is *lower*. This makes sense as these are the markets where the realized profit from undercutting is lower.

Result 3. *Actual mergers seem to be unrelated to market prices and the level of collusion. We attribute this to the fact that, although (a) mavericks are the primary targets of merger offers, (b) they are not more likely to accept these offers.*

4.2.1 Discussion

Where does the reluctance to sell come from? After all, monopoly virtually guarantees a price of 100, and prevents any miscoordination on price. Reminiscent of the insider dilemma in Cournot oligopolies, one reason might be that the maverick will have to share the profit with all three original competitors. For example, if there is one maverick remaining against one merged firm from the other three original competitors, and if the maverick expects she can sustain a price of at least one fourth of the monopoly price, she will do better by not agreeing to a merger proposal.

We can look at this issue empirically by using a rough approximation of the calculation that the acquisition target might perform during a merger phase. Table 3 shows the analysis of all merger offers. The dependent variable is whether the acquisition target agreed to the offer or not. The independent variables are the profit the target might expect from not agreeing to the offer and the profit she might expect from agreeing to the offer. We make the simplifying assumption that average posted prices are going to stay the same in the next market phase.[22] As

[22]This is, of course, a crude approximation. If the target declines the offer, competitors might start to fight the maverick harder; on the other hand, if the target agrees to the offer, the higher concentration might lead to even higher prices than the offering firm had previously bid. We take into account the larger number of co-owners in the merged entity, with which the acquisition

before we also include dummies for the number of competitors in the market and the phase. We find that the probability to accept a merger proposal increases weakly significantly if the expected profit of such a merger increases, and decreases if the the expected profit of declining the merger increases. We thus deem it plausible that mavericks tend to decline offers if they think they can sustain higher profits alone than having to share the increased pie with more owners after a merger.

Table 3: Regression Analysis of Acceptance of Merger Offers

	Accept
Projected Profit Decline	-0.124*
	(0.066)
Projected Profit Accept	0.308*
	(0.160)
# Firms = 3	-0.413**
	(0.168)
# Firms = 4	-0.073
	(0.152)
Phase 2	0.085
	(0.146)
Phase 3	-0.010
	(0.224)
Phase 4	-0.012
	(0.170)
Constant	0.436**
	(0.198)
R-squared	0.068
N	114

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.3 Additional Treatments

Our key hypothesis was that mergers are used as a tool to overcome failing collusion. To explore this idea, we designed additional treatments that were intended to

target would have to share the profit, but we ignore any timing of offers within the merger phase. For example, another merger might have happened after making the offer and before accepting it. If firms would merge to monopoly, we assume that participants anticipate a market price of 100. Finally, we only include cases where the target receives exactly one offer.

make (i) collusion easier or (ii) merging less appealing. To achieve the former, we implemented a COMMUNICATION treatment condition where participants had the opportunity to send chat messages before each period in the Market Phase.[23] Our final treatment condition, DUOPOLY, eliminates the possibility to form a monopoly; that is, the smallest number of firms a market can reach is two. Since the bulk of the gain from concentration comes from reaching monopoly (recall Figure 3), we conjectured that shutting off this prospect would make mergers less attractive in expectation.

4.3.1 Results COMMUNICATION

We conducted one session of this treatment, with 7 four-person markets. Although communication is cheap talk and material incentives are identical to the MERGER condition, COMMUNICATION dramatically improves collusion to monopoly level. Indeed, only in 9 out of 240 instances (3.75 percent) of markets with more than one active participant did *not* result in a price of 100.[24] The average market price in quadropolies is 99.00, in triopolies is 100.00, in duopolies 99.98.

Despite the near-perfect success of collusion, 5 out of the 7 groups merged all the way to monopolies. While this is a lower fraction than in MERGER, it is still the majority of groups. An investigation of the chat contents shows that groups did not only discuss price collusion but also mergers. The most frequent rationale for merging was the anticipation of an end-game effect, where collusion may break down in the final rounds of the experiment. Merging was thus seen as a tool to prevent this from happening.

Interestingly, the two groups that did not reach monopoly remained quadropolies throughout the experiment while still maintaining monopoly-levels of collusion.

[23] Chats were between members of the same four-person group. Only owners of firms could participate actively, that is, after selling their firm(s), participants could not write messages any longer. In the first two periods of each market phase, the chat window was open for 1 minute, in subsequent periods this time was reduced to 30 seconds.

[24] In this session, once the market reached monopoly, the computer automatically set the price to 100.

4.3.2 Results DUOPOLY

As with COMMUNICATION, we ran one session of DUOPOLY with 7 four-person groups. The ban on monopolies did not diminish merger behavior. 6 out of the 7 markets still had merged to duopolies by the end of the experiment. Keeping market size equal, average prices in DUOPOLY were similar to MERGER, although quadropolies tend to produce higher prices.[25]

5 Conclusion

Antitrust law and merger analysis suggest that mergers may help collusion by reducing the number of independent decision makers as well as by eliminating maverick firms. But do collusive purposes motivate merger activity, and if so, what role do mavericks play? We introduce a novel experimental design that combines Bertrand oligopoly experiments with intermittent opportunities for the market participants to merge. This design allows us to jointly investigate price effects of mergers and the nature of the merger process.

We find that the possibility to merge is widely used: all experimental markets experience at least one merger, and 19 out of 23 markets eventually end up in a monopoly. We also find strong evidence for coordinated effects of mergers. Prices exceed marginal costs in the post-merger market and, in line with existing experimental evidence, we find support for the common wisdom that they increase with market concentration. We hypothesized that mergers may be used to eliminate mavericks from the market and thus substitute for failed attempts at collusion between firms. We find that indeed, more merger offers are made when market prices are low, and that mavericks are the primary targets of these offers. However, the number of actual mergers is not significantly related to market price. When we analyze the behavior of the target firms, we find that mavericks are not more likely to accept a merger offer than non-mavericks, and merger offers are more likely to be accepted in markets with more collusive prices.

Overall, our study lends support to the practice of scrutinizing merger attempts that involve mavericks. In practice, by neglecting the maverick argument a merger

[25] Average quadropoly price in DUOPOLY was 46 ECU versus 23 ECU in MERGER, difference to MERGER not statistically significnant.

may be seen as enhancing competition by making, for example, a second-place firm more capable of competing against a first-place firm. The involvement of a maverick thus matters for the decision to block a merger. Moreover, our finding that mavericks are more likely to be the merger target when the market is more competitive sheds an interesting light on the current practice to view a market as particularly vulnerable to coordinated effects post-merger if there is a history of collusion in that market pre-merger. Our finding in fact suggests that in a market where firms *fail* to collude without merging, a merger may serve a collusive purpose and hold the potential for coordinated effects.

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Appendix

Price Spread

We show in the main article that the price increases as the market concentrates to duopoly, and finally monopoly. Concurrently, the agreement of posted prices between firms increases, in that the spread between the highest and lowest posted price in any given round decreases (Figure A1).

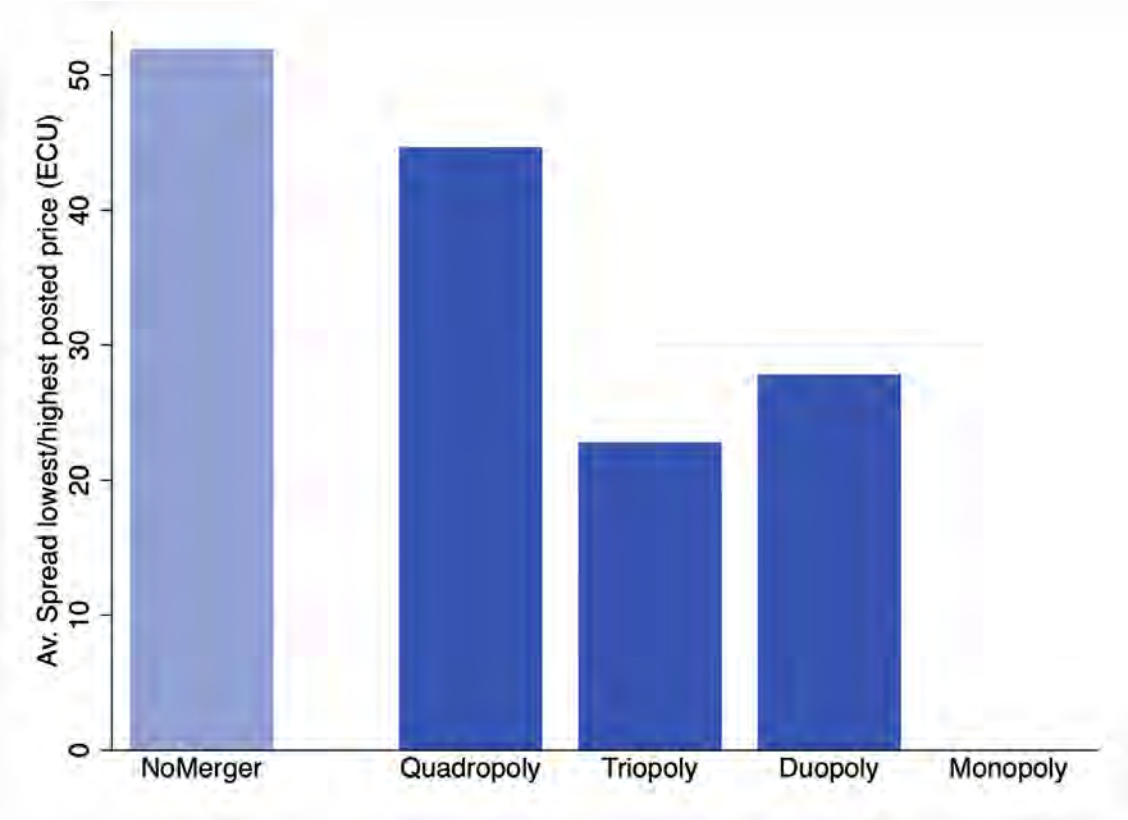


Figure A1: Average Price Spread in the MERGER and NOMERGER Treatments

Table A1 shows the corresponding regressions, using only data from the MERGER treatment.

Analogously to the price level analysis in the main text, Model (1) in Table A1 only includes competitor number dummies, while Model (2) also includes period dummies. The regressions confirm the visual impression that the discrepancy of posted prices decreases with increasing concentration.

Table A1: Regression Analysis of Market Price Spread

Dep. Variable	Price Spread	
	(1)	(2)
3 Firms	-22.889**	-48.765***
	(6.963)	(13.548)
2 Firms	-19.019	-46.685*
	(12.303)	(18.139)
1 Firm	-29.356**	-65.870***
	(11.630)	(22.149)
Period Dummies?	No	Yes
Constant	40.313***	38.391***
	(7.887)	(5.692)
R-squared	0.070	0.134
N	1150	1150
Clusters	23	23

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Instructions for Participants

Instructions for the MERGER Treatment. Additional text in red belongs to the COMMUNICATION Treatment, additional text in orange to the DUOPOLY Treatment. The NOMERGER instructions are identical to MERGER but without the description of the merger mechanism.

General information

Thank you for participating in today's experiment.

I will read through a script to explain to you the nature of today's experiment as well as how to navigate the computer interface with which you will be working.

In addition to a CHF 20 payment that you receive for your participation, you will be paid money that you accumulate from the decision tasks that will be described to you in a moment. The exact amount you receive will be determined during the experiment and will depend on your decisions and the decisions of others. At the conclusion of this experiment, this amount will be paid to you privately and in cash. That is, no one will ever know your decisions or how much money you made.

All monetary amounts you will see in this experiment will be denominated in Experimental Currency Units or ECU. We will convert ECU into CHF at the rate of

5000 ECU = 1 CHF.

If you have any questions during the experiment, please raise your hand and wait for an experimenter to come to you.

Please do not exclaim or talk with other participants during the experiment. Do not use the computer in a way not specified by these instructions or by the experimenters. Participants intentionally violating the rules may be asked to leave the experiment with only their participation payment.

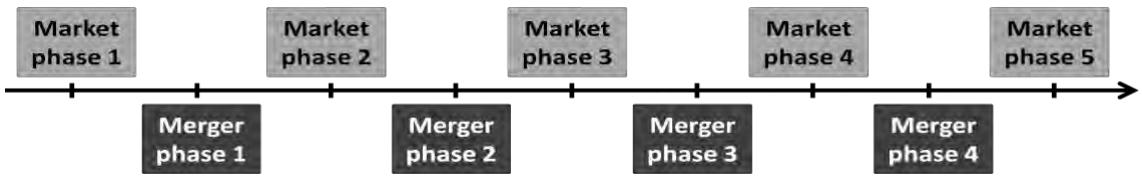
All numerical examples in these instructions are used simply to provide examples and do not represent any hints or suggestions for how you should make your decisions during the experiment.

General procedures

At the beginning of the experiment all participants are **randomly matched into groups of four**. Each participant is part of one group and the **group composition does not change** throughout the entire experiment. Group members interact within their group but not with other groups.

The **identity of each participant** and thereby all **decisions remain anonymous** throughout the entire experiment.

The experiment consists of **five market phases** and **four merger phases**. Market and merger phases alternate as illustrated below.



In the following we will explain the market and merger phases in detail.

Market phase

Each single market phase consists of **10 periods**. Thus, in total there will be 50 market periods.

Firms

In the beginning of this experiment each participant will be **in the role of a firm owner.** The firms of **all four group members interact in the same market**. The firms in one market are labeled as firm A, B, C, and D.

Each firm produces some good and there **are no costs of production**.

Consumers

The market consists of **300 identical consumers**. Each consumer will purchase **one unit of the good at the lowest price**. The consumers will **pay up to 100 ECU** for a unit of the good, but not more. Consumers are simulated by the computer.

Price decisions

In the beginning of each period, all firm owners decide on the price offered by their firms. Prices can range from 0 to 100 ECU. The **firm that offers the lowest price in the market will sell 300 units of the good at the offered price**. If **more than one firm** offers the lowest price, they will **split** the 300 **consumers equally**. Firms offering a **higher price** will not have any consumers left to supply and **will not sell any units** of the good.

Communication

Before making their price decisions, firm owners will be able to **communicate with other firm owners in their market**. To send a message type the text in the blue field at the bottom of the chat box on the screen and press the "ENTER" key on the keyboard:

All messages sent are **visible to the entire four-person group**. The writers of messages will be **identified through the labels of the firms** they own.

In the **first two periods of each market phase**, firm owners will be able to **send messages for 1 minute**. Afterwards, the **duration of the chat will be reduced to 30 seconds**. Firm owners are **allowed to send as many messages as they like**. There are only two restrictions on messages: you may not post messages that reveal your identity (e.g. age, gender, location etc.) and you may not use offensive language.

The chat box **disappears** either **automatically after the time has elapsed or when all firm owners have clicked the "LEAVE CHAT" button** at the bottom of the screen. When the chat box closes the price decision field appears.

Profits

In each period the firm's profit is calculated as follows:

profit = [price offered] x [consumers supplied]

Example 1

Suppose that the four firms offer the following prices: Firms A, C, and D each offer a price of 85 ECU and firm B offers a price of 75 ECU. Firm B offers the lowest price and therefore sells 300 units at a price of 75 ECU, making a profit of 75 ECU x 300 = 22'500 ECU. Firm A, C, and D will not supply any consumers, therefore making 0 ECU.

Example 2

Suppose that the four firms offer the following prices: Firms A, B, C, and D each offer a price of 70 ECU. Given that firms A, B, C, and D offer the same price, they will have to share the 300 consumers equally. Hence, all four firms will sell 300/4 = 75 units at a price of 70 ECU, therefore making a profit of 70 ECU x 75 = 5'250 ECU.

Information

After each period, all group members are informed about the **prices offered by all firms in the market**, the resulting **market price**, and their **own payoff** in the previous period.

Merger phase

After the 1st, 2nd, 3rd, and 4th market phase, a merger phase takes place. Each merger phase offers the opportunity to **firm owners to sell their firm** and to **acquire other firms**.

Procedures

Firm **owners can make proposals** to acquire other firms and **accept a proposal** received from other firm owners. How to use the computer interface to make and accept proposals will be explained in the next section.

We refer to merged firms as entities. Acquisitions are irreversible, that is, the owner of an entity **cannot split the entity up** again. But an entity can acquire additional firms in later merger phases. **In any given merger phase** each firm owner can **only participate in one merger**.

A group member can eventually **own up to four** */ three* **firms**. A merger that would result in one group member owning all four firms is therefore *not* allowed. Thus, the minimum number of firm owners in a market is one / two. If this minimum is reached, no further merger decisions are possible. Note that this does not affect the total number of market phases.

Decision rights

By selling a firm the **seller transfers his/her decision rights to the acquirer**. It is the acquirer's right to **decide on prices** in the following market phases for all firms he/she then owns. The acquirer also has the right to **decide on further mergers**.

Therefore **after selling his/her firm, a participant cannot make any decisions** in the remainder of the experiment. Additionally, a seller cannot send messages anymore to the firm owners in his/her market. Nonetheless, he/she is informed about all decisions in the market, can see all messages sent in the chat, and receives payoffs.

Compensation

There is **no one-time payment** for a merger.

Instead, **acquirer and seller(s) share post-merger profits of the entity equally**. This means that in all future market periods, an acquirer has to equally share the total profits made by all his/her firms with all former owners of these firms.

The individual payoff of both acquirer and seller(s) in a market period is calculated as follows:

payoff = [entity's total profit] / [number of firms in the entity]

Example 3

Suppose that at the beginning of the experiment, four participants, 1, 2, 3, and 4, are matched into one group. Participant 1 starts out owning firm A, participant 2 owns firm B, participant 3 owns firm C, and participant 4 owns firm D.

1) *In the first merger phase, participant 3 makes a proposal to acquire firm A. Participant 1 accepts the proposal to sell his/her firm. Thereby firm A and firm C merge and participant 3 is the owner of the entity CA. Note that the **first letter** in the name of the new entity, "C", indicates the initial firm of the **acquirer**, participant 3. In all following periods, participant 1 cannot make any decisions but will receive half of entity CA's total profits.*
   In the following market phase, participant 3 decides on the prices for firm C and A. In one period he/she sets a price of 80 ECU for firm A and a price of 70 ECU for firm C. Firm C's price is the lowest price in the market. No other firm offers the same price. Hence, firm C sells 300 units at a price of 70 ECU and makes a profit of 70 ECU x 300 = 21'000 ECU. Firm A, B, and D will not supply any consumers, therefore making 0 ECU. Participant 3 equally shares entity CA's total profits of 21'000 ECU + 0 ECU with participant 1. In this period, each of the two gets a payoff of 10'500 ECU.

2) *In the second merger phase, participant 4 makes a proposal to participant 3 for entity CA. Participant 3 accepts the proposal and thereby sells CA to participant 4. Now, participant 4 owns firm D, A, and C. Participant 3 cannot make any decisions but will receive a third of entity DAC's profits. The same is true for participant 1.*
   In the following market phase, participant 4 decides on the prices for firms D, A, and C. In one period he/she sets the same price of 75 ECU for all three firms D, A, and C. This is the lowest price in the market. Firm B offers a higher price. Hence, each of participant 4's three firms sells 100 units at a price of 75 ECU and makes a profit of 100 x 75 ECU = 7'500 ECU. Firm B will not supply any consumers, therefore making 0 ECU. Participant 4 equally shares entity DAC's total profit of 3 x 7'500 ECU = 22'500 ECU with participants 1 and 3. In this market period, each of the three gets a payoff of 7'500 ECU.

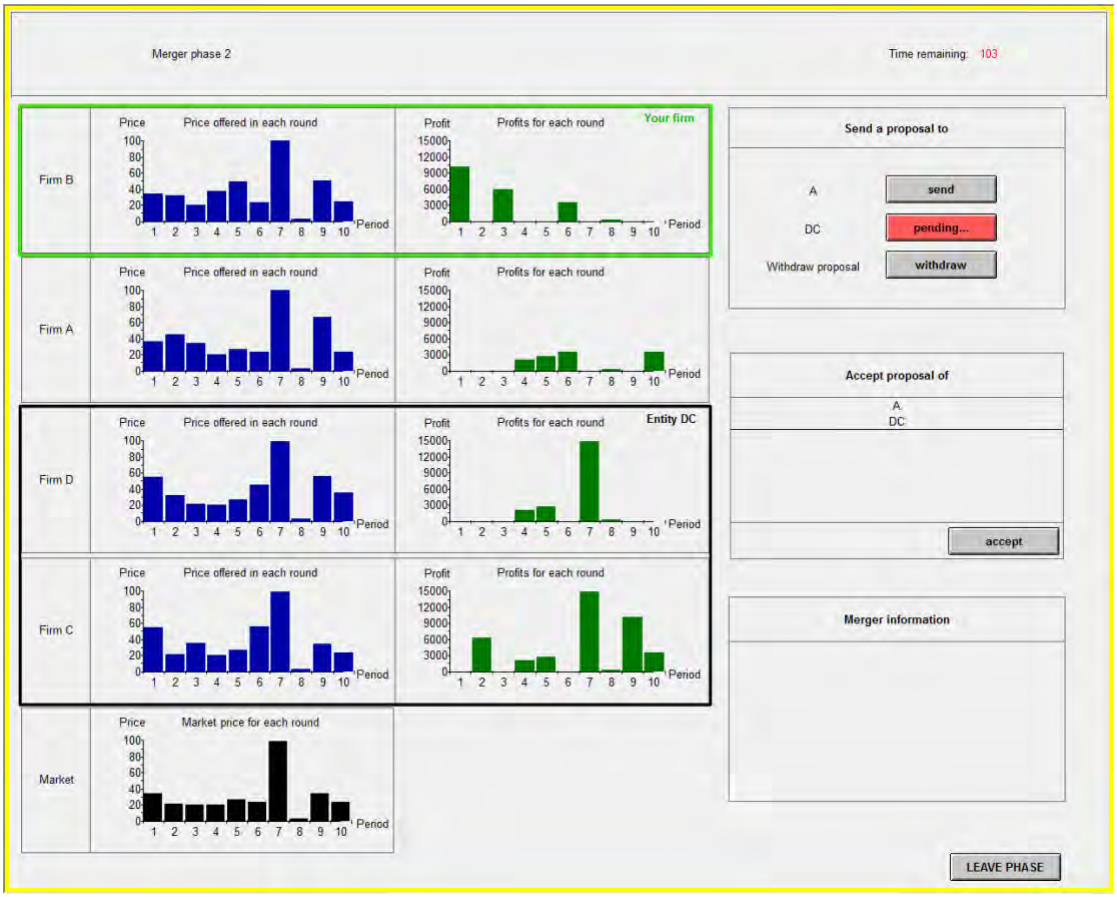
Computer interface in the merger phase

Before the merger phase starts, all group members receive **information about the previous market phase**. Please note that this information is also displayed even if there is no further merger phase, which happens in case one group member already owns four / three firms. The information remains visible throughout the entire merger phase and is described in detail below.

To enter the merger phase, please click the **"I AM READY"** button at the bottom of the screen. The **two-minute merger phase starts** once all group members have clicked the "I AM READY" button.

Overview

The computer interface (see below) displays the information about the previous market phase on the left hand side and gives firm owners the opportunity to make decisions on the right hand side.



Information about the previous market phase

Group members are informed about **prices offered** and **profits earned** by all firms in the market in the previous market phase. Firms merged to one entity are grouped into one box. The firms you own are shown at the top and framed in light green. Additionally, the resulting **market price** in each period is provided at the bottom.

Acquiring and selling decisions

Firm owners can **make proposals** to any other firm owner in the market to acquire his/her firm. A proposal is sent by clicking on the respective button in the box placed at the top. Note that it is **not possible to make a proposal to more than one firm owner at once**. A pending proposal is marked in red. As long as their proposal has not been accepted, **firm owners can change their mind**: they can simply send a proposal to another firm owner or withdraw their proposal.

Proposals **are immediately displayed at the respective firm owner's screen** in the box placed in the middle. A proposal can be accepted by **clicking on the proposal in the list** and **clicking the "accept" button** below. An **accepted proposal is binding** and cannot be changed. Firm owners thereby sell their firms and decision rights.

In the box placed at the bottom, accepted proposals are announced publicly to all group members.

End of the merger phase

The merger phase **ends** either **automatically after 2 minutes or when all firm owners have clicked the "LEAVE PHASE" button** at the bottom of the screen.

Before a new market phase starts, all group members are informed of all acquisitions that took place.

Total payoff

Your **total payoff** is the **sum of the payoffs earned in all 50 market periods**. At the conclusion of the experiment this payoff will be converted to CHF and paid to you in addition to your participation payment.

Practice questions

Before the experiment begins, we will first ask you to answer some practice questions. This is done to make sure that everyone understands how decisions are made and payoffs are calculated.

Please try to solve the practice questions and click the “Submit answers” button.

Recall, that whenever you have a question or are confused, please raise your hand and wait for the experimenter to come to you.