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The Lingering Effect of Capacity Coordination on Firm Behavior in Post-depression Periods: Evidence from a Laboratory Experiment

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Abstract
This study experimentally examines whether capacity coordination in depression, which is sometimes allowed under antitrust laws, influences the firm behavior in periods after demand recovers. Following Hampton and Sherstyuk (2012), we conducted a series of laboratory experiment by adopting the two-stage capacity-price decision-making duopoly setting. We adopted three treatments in terms of capacity coordination: no coordination, weak coordination, and strong coordination. Under the strong coordination treatment, the subjects cannot deviate from the coordinated capacity, which they can do so under the weak coordination treatment. The results of the experiment indicate that the experiences of success and failure of coordination influence subjects' capacity choices during periods after demand recovers even if capacity coordination is not allowed in those post-depression periods. In particular, capacity may be greater in the post-depression periods than in the pre-depression periods under the weak coordination.

Keywords: Capacity coordination, demand shocks, lingering effect, laboratory experiment.
JEL Classification: K21, L41.

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1. Introduction

In general, antitrust laws ban cartels, such as price cartels, and capacity coordination among producers. However, when certain conditions are satisfied, firms may be able to form cartels to coordinate their prices and capacities with each other. For example, until 1999, counter-recession and rationalization cartels were allowed under the Act on Prohibition of Private Monopolization and Maintenance of Fair Trade in Japan. Another example is related to international transportation. Until the late 1990s the container shipping industry across the world was granted antitrust immunity. Historically, with antitrust immunity, shipping liners cooperatively determined shipping charges and load capacity for the same sea line. The cooperative groups were called shipping conferences.

The purpose of implementing this policy was to realize a stable supply of production capacities. In the case of international marine transportation, excess capacity problems often become apparent under recessions because the capacity cannot be flexibly changed once the vessels are constructed. If price competition becomes serious under recessions, liners cannot make profits. In addition, they have to keep excess capacities without operating them. Or, they have to scrap container vessels even if they can still be used, which is also costly. Thus, capacity coordination may avoid this type of loss in terms of both profits of shipping liners and social surplus.

However, as the negative effect of antitrust immunity, including the authorization of cartels, which is a hindrance to competition, is believed to increase over time, antitrust immunity has been removed in many countries such as the US, the EU, and Japan for the past two decades. However, some countries have retained types of conditional antitrust immunity, in particular, for industries in which firms have to incur huge amounts of fixed costs, such as international transport industries. Of late, the governments and the transport industry have been discussing this issue (Bonney, 2012; King, 2012). Japan Fair Trade Commission also

released the Review of the System for Exemption from the Antimonopoly Act for International Ocean Shipping.[1]

Capacity coordination and other types of cartels among firms decrease social surplus in the short run. In this respect, the ban on cartels is justified. On the other hand, as noted above, the exemption from antitrust laws may be justified during times of depression to avoid the wastage of production capacities. The problem of high sunk costs and capacity coordination has been a major issue in economics (Kreps and Scheinkman, 1983; Sjostrom, 1989; Durham et al., 2004). Many empirical studies have also shed light on the effects of antitrust immunity (Albaek et al., 1997; Brueckner et al., 2011; Brueckner and Proost, 2010; Kamita, 2010; Levenstein and Suslow, 2006; Rees, 1993; Staiger and Wolak, 1992).[2]

Moreover, economic experiments are attempting to resolve various aspects of this issue (Apesteguia et al., 2007; Dufwenberg and Gneezy, 2000; Hinloopen and Soetvent, 2008; Huck et al., 2004). However, these experiments mainly focus on periods in which capacity coordination is enforced, and they are conducted under conditions of stable demand. One exception is Hampton and Sherstyuk (2012), who introduced demand shock into their laboratory experiment. They, too, focused on the effects of capacity coordination in periods of reduced demand.

In contrast to the literature on capacity coordination that uses economic experiments, we investigate the effect of capacity coordination in depression on the market and firm behavior in the periods after demand recovers (post-depression periods). It is obvious that capacity coordination in depression influences the firm behavior during depression. However, its effect in the period after demand recovers has not yet been examined. That is, we examine if

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[1] See the website of Japan Fair Trade Commission for this press release.
http://www.jftc.go.jp/en/pressreleases/yearly-2016/February/160204.html

[2] Recently, it is considered that alliances may influence the market of international transportation and the effect of antitrust immunity. For the analysis of the international transport industry in terms of alliances, see Fox (1994), Bruckner (2001), Bilotkach (2007), Flores-Fillol and Moner-Colonques (2007), and Czerny (2009) among others.

experiences of capacity coordination influence firm behavior during post-depression periods in which capacity coordination is not allowed.[3] If the effect of capacity coordination lingers after demand recovers or a type of rebound effect occurs, the authorities in charge of antitrust immunity may have to take these effects into consideration.

To this end, we adopt a two-stage capacity-price decision-making duopoly scenario. The theory behind this model was developed by Kreps and Scheinkman (1983), and it has been applied in economic experiments by several researchers (Davis, 1999; Muren, 2000; Goodwin and Mestelman, 2010; Hampton and Sherstyuk, 2012). Following Hampton and Sherstyuk (2012), we introduce a demand shock in the middle of the experiment. In addition, contrast to their experimental design, we also conduct several rounds in which the demand condition recovers and becomes normal after a demand shock.

We conduct three treatments in terms of capacity coordination: no coordination, weak coordination, and strong coordination, which correspond to no negotiation, negotiation with punishment, and negotiation without punishment treatments in Hampton and Sherstyuk (2012), respectively. Under strong coordination, subjects cannot deviate from the coordinated capacity, whereas, under weak coordination, they can deviate from it. The results of the experiment indicate that (i) strong coordination significantly reduces capacities during periods of demand shock vis-à-vis other coordination treatments and (ii) weak coordination is not effective. These results for depression periods are similar to Hampton and Sherstyuk (2012), although they also compare the speed of convergence among treatments. Moreover, we find that the experiences of success and failure of coordination influence subjects' capacity choices during periods after demand recovers even if capacity coordination is not allowed in those post-depression periods. In particular, capacity may be greater in the post-depression periods than in the pre-depression

[3] In this respect, this study is also related to the field of experience and behavior. For example, Fisman et al. (2015) experimentally investigate the effect of experience of great recession on preferences. Moreover, Voors et al. (2012) and Callen et al. (2014) examines the effect of violence on preferences.

periods under the weak coordination.

The rest of the paper is organized as follows. Section 2 describes the design of the experiment. Section 3 focuses on the results of market variables, such as market capacity and sales, and examines the effect of capacity coordination using the Wilcoxon one-signed ranks test, Wilcoxon-Mann-Whitney rank-sum test, and Welch's t-test. Section 4 focuses on individual behavior and investigates the factors that influence subjects' capacity choices. Section 5 examines surpluses, and Section 6 concludes the paper.

2. Design of the Experiment

2.1 Design and Demand Structure

We follow the basic design in Hampton and Sherstyuk (2012), which is a type of two-stage capacity-price-choice duopoly model. Two subjects are randomly paired in each session, and they enter the same market throughout the session they participated in. Both the subjects act as sellers in the market under specified demand conditions that are certainly known to them. Basically, each round consists of two stages: First, both the subjects make simultaneous capacity choices. When both/all the subjects determine their capacities, each subject is informed about the capacity chosen by the other and the total capacity of the market that s/he enters. Second, each subject chooses the price simultaneously.

Each seller faces a constant marginal cost for holding capacity, which is ten experimental dollars per unit.[4] As our purpose is to observe individual behavior and market situations during and after the periods of a demand shock, we exclude the fixed cost because it makes the structure of the experiment complicated and confusing. However, subjects must pay marginal costs according to the capacity they possess rather than the amounts of goods production. Even if the production amount is smaller than the capacity, the cost is equal to ten

[4] We use the term "experimental dollars" for the money used in experimental sessions.

experimental dollars times the capacity. Thus, this marginal cost may act as a fixed cost in the sense that the cost is sunk when they choose their prices.

We also use the demand conditions designed by Hampton and Sherstyuk (2012) for both the normal and the demand shock situations. In the first six rounds (round 1 to round 6), each subject faces a demand condition given by

$$Q = 304 - 4p \quad (1)$$

where Q and p denote the total supply by the two entrants and the market price, respectively. We refer to this first six rounds as the pre-shock phase. For the next six rounds (round 7 to round 12), the demand condition is given by

$$Q = 256 - 4p. \quad (2)$$

We refer to these six rounds as the mid-shock phase. Finally, the demand increases and returns to its original state, which is indicated by equation (1). We refer to the six rounds conducted at this point as the post-shock phase. Note that the meaning of post-shock in this paper is different from that in Hampton and Sherstyuk (2012). Here, the demand structure is the same as that in the pre-shock phase. In the experiment, the table of quantities and prices that reflects demand condition (1) is distributed at the beginning of the experiment, while that for condition (2) is distributed at the beginning of the seventh round.

There are two important merits of using the supply and demand conditions adopted by Hampton and Sherstyuk (2012). First, as noted by them, three plausible theoretical benchmarks, Bertrand, Cournot, and monopoly outcomes, are clearly compared under these demand conditions. Second, by adopting the same demand conditions, our results can be compared to those obtained by Hampton and Sherstyuk (2012).

2.2 Treatments

We adopt three main treatments. The first is the basic treatment, which is referred to as the

no coordination treatment. This treatment is also considered as controlled sessions. For all of the pre, mid, and post-shock phases, subjects repeat the same two-stage decision-making process in each round. As noted above, the subjects choose their capacities in the first stage (Stage 1), and after receiving the information about the capacity of the other market participant, they choose the prices of their products in the second stage (Stage 2). The only variation they face is a demand shock: the demand suddenly decreases from condition (1) to condition (2) at the beginning of the seventh round.

At the beginning of each round, the subjects receive information on the demand condition. They are also made aware that there is a possibility that demand conditions may change in the beginning of sessions. However, they do not know when and how the demand conditions will change until the beginning of each round. As such, the demand suddenly increases from condition (2) to condition (1) at the beginning of the thirteenth round.

The second treatment is the strong coordination treatment. The subjects carry out the same two-stage decision-making process of the pre-shock phase. Moreover, they face the sudden decrease in demand at the beginning of the seventh round. For the mid-shock phase, one more stage, Stage 0, is added before choosing the capacities. In each round, the subjects receive a suggestion from a coordinator, who is called *market administrator* in the experiment's sessions to prevent the subjects from imaging specific situations. The administrator corresponds with industrial associations or authorities in the real world. The suggestion is as follows: "Your capacity is equal to 54, and the capacity of the other market entrant is 54." The total capacity of 108 is equivalent to that chosen by the monopolist. This suggestion does not change throughout the mid-shock phase.

Then, the subjects are requested to reveal whether they accept or reject the suggestion. In this treatment, if both subjects accept the suggestion, they are unable to change the capacity in Stage 1, which means that the capacities of both subjects in the market automatically equal 54

and they proceed to Stage 2. In Stage 2, both the subjects choose their prices like they did in the pre-shock phase. On the other hand, if one of the two subjects rejects the suggestion, or if both of them reject it, they face the same situation in Stages 1 and 2 as they did in the pre-shock phase. They get to know that they failed in coordination. However, when a subject rejects the suggestion, s/he does not receive information about the choice of the other participant on capacity coordination. They choose their capacities and prices by themselves in Stages 1 and 2, respectively. For the post-shock phase, the process is the same as that under the no coordination treatment.

The third treatment is the weak coordination treatment. The subjects carry out the same two-stage decision-making process of the pre-shock phase. Moreover, they face a sudden decrease in demand at the beginning of the seventh round. For the mid-shock phase, similar to the strong coordination treatment, one more stage, Stage 0, is added before choosing the capacities. The subjects receive a suggestion from the market administrator whose contents are the same as those in the strong coordination treatment. This suggestion does not change throughout the mid-shock phase.

The subjects are requested to reveal whether they accept or reject the suggestion. Unlike the strong coordination treatment, even if both the subjects accept the suggestion, they are able to change their capacities in Stage 1. That is, after receiving information about their success in coordination, they carry out the same decision-making process as in the pre-shock phase. If one of the two subjects rejects the suggestion, or if both of them reject it, they face the same situation in Stages 1 and 2. They choose their capacities and prices by themselves in Stages 1 and 2, respectively. For the post-shock phase, the process is the same as that under the no coordination treatment.

2.3 Sessions and Procedures

We conducted six no coordination, six strong coordination, and five weak coordination treatments. In each session, the number of participants were eight, ten, or twelve, which implies that the number of markets in each session was four, five, or six. The subjects are undergraduate students of Kwansei Gakuin University. See Table 1 for the details of the sessions. We did not exclude students of any specific departments. Thus, our sample covers students who specialize in various fields including business, economics, law, literature, and social studies. Each student participated in only one session and those students were paid an average of $35 based on their results.[5] In the beginning of each session, the subjects were made to read the instructions for about 10 minutes. Then, for a more precise understanding of the instructions, an instructor read them out loudly.

In each round, 90 seconds are given to the subjects to determine their capacities in Stage 1. When all the subjects determine their capacities, they proceed to Stage 2. At this stage, the subjects were given 120 seconds to determine their prices. They are allowed to use the calculator function on their computer screens. When a subject determines the price, s/he enters the price and clicks the "OK" button. However, s/he is requested to write down the expected price of the other participant on the record sheet before clicking the button.[6] When all subjects determine their prices, they proceed to the recording stage in which they write down the results (sales amounts, prices, profits of both participants). This recording stage continues for 30 seconds. After the experiment, the subjects answer a questionnaire that can measure their risk preference. Moreover, under the strong and weak coordination treatments, 20 seconds are given to subjects to determine if they accept or reject the suggestion by the coordinator in Stage 0.

In this paper, we may use technical terms specific to industry and cartels to describe the

[5] This amount is calculated based on an exchange rate of ¥115=$1.
[6] As the program allows subjects to click the "OK" button without writing down the expected price, the expected prices of some subjects were not obtained in some rounds.

experimental design and the results. However, in the experiment, the subjects were shown more neutral terminologies. We conducted the experiment using the University of Zurich's A-tree program (Fischbacher, 1999).

3. Results

3.1 Overall Results: Averages and Medians

First, we look at the aggregate data, averages, and medians, to get an overview of the situations in our experiment. Table 2 gives the average market capacities and sales for each treatment. As the market capacities/sales is the sum of the capacities/sales of the two sellers in each market, the average individual capacities/sales can be obtained by dividing its values by two.

In the pre-shock phase, both capacities and sales increase gradually under all of the three treatments. In addition, it is likely that capacities and sales approach 220 and 180, respectively. When we observe the medians of these variables (Figure 1), the trends are the same, although the median capacity seems to approach 200, which is a less than 220. These results are similar to those obtained by Hampton and Sherstyuk (2012). Moreover, although these variables in their results seems to decrease through periods, sales in some treatments increase for the first several periods. For the pre and post-shock phases, the monopoly, Cournot, and Bertrand outcomes are 132, 176, and 264, respectively. Thus, the quantities lie between the Cournot and the Bertrand outcomes.

In the mid-shock phase, both average capacities and sales decrease suddenly. This is intuitive because a demand shock occurs. The subjects are assumed to adjust their capacities to the decrease in demand. Interestingly, capacities and sales under the strong coordination treatment are likely to decrease by a greater amount than under the weak and no coordination treatments. On the other hand, the decreases in capacities and sales under the weak and no

coordination treatments seems to be similar to each other. The same results are obtained when observing median capacities and sales. For the mid-shock phase, the monopoly, Cournot, and Bertrand outcomes are 108, 144, and 216, respectively. Thus, the quantities under the weak and no coordination treatments lie between the Cournot and the Bertrand outcomes, while those under the strong coordination treatment lie between the monopoly and the Cournot outcomes.

In the post-shock phase, both average capacities and sales recover under all treatments. The average values are similar to those in rounds 5 and 6 under the no coordination treatment; smaller under the strong coordination treatment; and greater under the weak coordination treatment. Further, when we observe median capacities and sales the results are different from those for the average capacities and sales. Under the strong and no coordination treatments, the median values are similar to those in rounds 5 and 6, while under the weak coordination treatment, they are larger. It is interesting that variables in two extreme treatments, in terms of strength of coordination, indicate similar trends.

Moreover, it should be noted that both average and median capacities/sales are more stable in the post-shock phase than in the pre-shock phase. Although the number of rounds in our experiment may be relatively small for capturing the long-term convergence of these variables, the similarity in the values of our sessions with those in Hampton and Sherstyuk (2012) as well as the stable trend indicate that our data is rich enough to analyze the behavior of subjects and compare the market outcomes of all the three phases.

Table 3 gives the average prices and profits in different rounds under each treatment, while Figure 1 depicts the median prices and profits. We obtain the same results for outcomes, trends, comparisons, and stability as those obtained by observing the capacities and sales. Table 4 gives the standard deviation of market capacity, which reveals that the capacities become more stable over the periods and converge to certain values.

3.2 Cross-phase Comparisons of Market Variables

We use statistical methods to verify if the remarks on the market variables in the previous subsection are correct. We begin with cross-phase comparisons to evaluate the effect of demand shocks. We use the results of the Wilcoxon Signed-ranks Test for this purpose. Tables 5 and 6 give the results of the test for capacities and sales, respectively. The results of the first five rounds verify if the subjects are able to adjust their capacities/sales soon after demand shocks occur. In addition, the results of the last two rounds compare the capacities/sales after they become stable. Even though they are relatively stable in the later periods, as the values change constantly in the first six rounds, the results of both the rounds are considered to be necessary to precisely capture the difference among the phases.[7]

First, we focus on the comparison between the pre and mid-shock phases (top-left box in each matrix). Under the no coordination treatment, capacities in the pre-shock phase are evidently different from those in the mid-shock phase. Although the result for the comparison of the first five rounds is insignificant, if we adopt the p-value for the one-sided test, sales in both the phases are significantly different at the 10 percent level. The differences are more significant under the strong coordination treatment as compared to the other treatments. The results of the first five rounds and the last two rounds indicate that the capacities and sales are significantly smaller in the mid-shock phase than in the pre-shock phase. The results of the weak coordination treatment are similar to those of the no coordination treatment.

Second, we investigate the difference between the mid and post-shock phases (bottom-right box in each matrix). Interestingly, the results of both capacities and sales under all of the three treatments are evident, and they are same for the first five rounds and the last two rounds. Capacities and sales are greater in the post-shock phase than in the mid-shock phase. These

[7] As we conducted 17 rounds for some sessions due to time constraints, we use the capacities and sales of the 16th and 17th rounds in the Wilcoxon Signed-ranks Test for the post-shock phase.

results indicate that the subjects adjust their capacities promptly when demand recovers.

Third, we investigate the difference between the pre- and post-shock phases (top-right box in each matrix). The stability of the variables in both the phases are quite different, and we do not need to verify the speed of adjustment of the subjects for this comparison. We focus on the results of the last two rounds. Under the no coordination treatment, the capacities in both the phases are not significantly different from each other, while sales in the post-shock phase are greater in the pre-shock phase. The possible reason for this relatively weak evidence of an increase in sales is that a type of rebound takes place. For example, if there is severe competition in the mid-shock phase, subjects become more aggressive in the post-shock phase than in the pre-shock phase. Under the strong coordination treatment, the differences are not significant for both capacities and sales. Considering the results of the comparison between the pre and mid-shock phases and those of the comparison between the mid and post-shock phases, it can be said that capacities and sales recover and return to the values in the pre-shock phase. The results under the weak coordination treatment are evident: capacities and sales in the post-shock phase are significantly different from those in the pre-shock phase. Table 2 and Figure 1 indicate that capacities and sales are greater in the former than in the latter. It is also surprising that the results of both the extreme treatments in terms of strength of coordination are similar.

Result 1. *Capacities and sales significantly decrease after the demand-decreasing shock and increase after the demand-increasing shock. This is common for all of the three treatments. On the other hand, the significance of the differences between capacities and sales in the pre and post-shock phases vary across treatments.*

3.3 Cross-treatment Comparisons

Now, let us examine the cross-treatment comparisons. We adopt the Wilcoxon-Mann-Whitney (WMW) rank-sum test for these comparisons. We also use Welch's t-test to complement the results of the WMW test. Tables 7 and 8 give the results of the WMW tests, while Table 9 gives the results of Welch's t-test. Similar to the comparison among phases, we obtain the results for all the rounds including the last two/three rounds.[8]

For the pre-shock phase, three tests indicate the same result: there is no significant difference in capacities and sales between any two treatments. This result is important and what we need to obtain, because if there is a significant difference between treatments in the pre-shock phase, we cannot verify the causes of the differences that arise in the mid and post-shock phases. This result indicates that there is no sample selection biases and that there is no difference in the conditions the subjects face in the pre-shock phase.

The three tests also indicate the same results for the mid-shock phase: (i) there is a significant difference in capacities and sales between the no coordination and the strong coordination treatments and between the strong coordination and the weak coordination treatments. In addition, there is no significant difference between the weak and no coordination treatments. It is clear from Table 2 and Figure 1 that capacities and sales are significantly smaller under the strong coordination treatment than under the other two treatments. This implies that a suggestion by the market administrator with binding coordination can work effectively, while a suggestion by the market administrator with non-binding coordination cannot affect capacities substantially.

For the post-shock phase, the common result of the three tests is that there are significant differences in capacities and sales between the no coordination and the weak coordination treatments, and between the strong coordination and the weak coordination treatments. This result indicates that capacities and sales is significantly greater under the weak coordination

[8] For comparison in the post-shock phase, we include the results of the 18th round.

treatment than in the other two treatments. With regard to the comparison between the no coordination treatment and the strong coordination treatment, the result of the WMW test for capacities is different from the result of the WMW test for sales, and the former is also different from the result of Welch's t-test. In the two tests, significant differences are observed. The p-values of the results of the last two/three rounds are greater than 0.1 even in the abovementioned tests. However, if we consider the p-values for one-sided tests, they are smaller than 0.1. Thus, average capacities are likely to be smaller under the strong coordination treatment than under the no coordination treatment.

Result 2. *(i) There is no significant difference in capacities and sales between any of the two treatments in the pre-shock phase. (ii) Capacities and sales are significantly smaller under the strong coordination treatment than under the other two treatments in the mid-shock phase. (iii) Capacities and sales are significantly larger under the weak coordination treatment than under the other two treatments in the post-shock phase. (iv) Capacities and sales are likely to be smaller under the strong coordination treatment than under the no coordination treatment in the post-shock phase.*

4. Individual Behavior

In this section, we delve into individual behavior of the subjects to shed light on the causes of the differences among treatments. Although our main focus is the post-shock phase, we begin with the behavior in the mid-shock phase to emphasize the difference in behavior in these two phases.

First, we focus on the capacity choices and the acceptance of coordination in the seventh round. For capacity choices, we estimate the following equation by using ordinary least squares (OLS).

$$\text{Capacity} = \alpha + \beta_1 risk + \beta_2 sumcapa + \beta_3 summcapa + \beta_4 sumearning$$
$$+\beta_5 sumdearning + \beta_6 td2.cartel + \beta_7 td3.cartel$$
$$+\beta_8 td2.choice.no + \beta_9 td3.choice.no$$

We adopt nine independent variables. *Risk* is risk preference of each subject. In the last part of the experiment, we ask 10 simple hypothetical questions to extract the risk preference of each subject. In each question, subjects choose one out of two alternatives/lotteries. Choice A is less risky than Choice B. The variable is the number of times each subject chooses Choice B. Thus, the variable is always an integer and takes a value in the range of 0 to 10. The greater the variable, the more risk the subject is willing to take. *Sumpcapa* and *Summcapa* are the sum of capacities of the partner of the subject and the sum of market capacities for six rounds in the pre-shock phase, respectively. We assume that these two variables may represent conditional cooperative behavior. *Sumearning* and *Sumdearning a*re the sum of earnings of the subject and the difference in the sum of earnings between the subject and the partner (the subject's earnings minus the partner's earnings) for six rounds in the pre-shock phase, respectively. There may be a case wherein the more payoffs a subject obtains, the less aggressively s/he behaves. The former variable represents this behavior based on her/his own cumulative payoffs, and the latter variable represents this behavior based on her/his relative payoffs. *td2.cartel a*nd *td3.cartel* are dummy variables that represent the acceptance of capacity coordination under the strong coordination treatment and weak coordination treatment. This variable is equal to 1 if both the subject and her/his partner accept the suggestion from the market administrator, and 0 if either one or both of them reject the suggestion. Under the strong coordination treatment, *td2.choice.no* is equal to 1 when a subject accepts the suggestion while her/his partner rejects it, and 0 otherwise. *td3.choice.no* corresponds to *td2.choice.no* under the weak coordination treatment. We adopt this variable to verify if refusal by the partners influences the capacity choices.

Moreover, for coordination choices, acceptance or rejection of the suggestion by the market administrator, we adopt the probit estimation. As subjects choose between acceptance and rejection simultaneously, they get to know if they succeed in establishing coordination after they determine their choices, we adopt the first five variables above as independent variables. Note that subjects who participated in the no coordination treatment are excluded from the sample for the probit estimation because they do not determine if they accept capacity coordination.

The results of the OLS and probit estimations are given in the first and the last two columns of Table 10, respectively. The coefficients of the sum of market capacities in the pre-shock phase are significant and positive. The result of the OLS estimation may indicate that the conditional cooperation holds. When they do not experience implicit cooperation, their capacities become larger. On the other hand, the result of the probit estimation may indicate that they want to prevent themselves from holding excess capacities by introducing an institutional setting, that is, an upper limit on the capacity. Although the coefficient of the sum of partner's capacities is negative in the OLS estimation, this may represent strategic substitutes between capacity choices of the two subjects in each market. Also, the size of the effect of the market capacity is greater than that of the partner capacity.

The coefficients of *td2.ach* and *td3.ach* in the OLS estimation are significant and negative, which implies that capacity coordination clearly decreases capacity choices of market entrants. An interesting point is that the coefficient of *td2.ach* (under the strong coordination treatment) is much larger than that of *td3.ach* (under the weak coordination treatment). The difference indicates that there are deviations from the suggested capacity, 54, under the weak coordination treatment.

Next, we focus on capacity choices in the mid-shock phase. We run a panel estimation for each treatment. Considering the possibility that values in the previous round affect individual

capacity choices, we adopt partner capacities, prices, and earnings in the previous period as independent variables. For example, *prepcapa* in Table 11 is the capacity of partner in the previous round, and *predprice* is the difference in prices in the previous period (the price of a subject minus the price of her/his partner). We also take into consideration the effect of success and failure of coordination: *cartel* and *choice.no*. The results are shown in Table 11, and interesting differences among treatments are observed.

Under the no coordination treatment, the capacity choice of a subject is significantly influenced by the capacity choice of her/his partner in the previous round. Because we do not adopt the market capacity as an independent variable, the negative sign may represent conditional cooperation. On the other hand, under both the strong and weak coordination treatment, the coefficients of *cartel* are significant and negative, while capacity choices of partners in the previous round does not affect capacity choice in the present round. Capacity coordination may sever relations of capacities between rounds.

Moreover, two important points should be noted. First, similar to capacity choices in the seventh round, the effect of capacity coordination under the strong coordination treatment is greater than that under the weak coordination treatment. Second, as far as the mid-shock phase is focused on, failure experience of capacity coordination does not significantly influence the capacity choice.

Result 3. *In the mid-shock phase, capacity choices under the no coordination treatment are influenced by partners' capacities in the previous round. On the other hand, capacity choices under the strong and weak coordination treatment are mainly influenced by the success of capacity coordination.*

Finally, let us examine the capacity choices in the first round of the post-shock phase

(Round 13). We use the OLS estimation and adopt 11 independent variables. The number of independent variables is larger in the estimation for capacity choices in the thirteenth round than that in the seventh round because we separate the sums of partners' and market capacities in the pre-shock phase from those in the mid-shock phase. For example, *sumpcapa.1* and *sumpcapa.2* are the sum of capacities of subjects' partners in the pre- and mid-shock phases, respectively. Moreover, we consider the number of times capacity is successfully coordinated in the mid-shock phase under the strong and weak coordination treatments (*td2.sumcartel* and *td3.sumcartel*). Similarly, *td2.cohice.no.sum* and *td3.choice.no.sum* represent the sum of the number of times a subject accepts the suggestion while her/his partner rejects it in the mid-shock phase under the strong and weak coordination treatments, respectively. We use these two variables for clarifying the effect of experiences of refusal.

The results are given in Table 12. The results of both estimations are consistent and clearer than those for capacity choices in the seventh round. First, all of the coefficients of partner capacities are significant and negative, which implies that strategic substitutes between capacity choices hold: a subject decreases her/his own capacity in response to an increase in her/his partner's capacity. Second, all of the coefficients of market capacities are significant and positive, which implies that conditional cooperation holds. An increase in capacity implies that the degree of implicit cooperation becomes lower. Thus, subjects are likely to behave non-cooperatively.

The effect of experiences of success and failure in establishing cooperation under the strong coordination treatment contrasts sharply with that under the weak coordination treatment. In the case of success experience, the coefficient of *td2.sumcartel* is significant and negative, while that of *td3.sumach* is insignificant, which implies that success experience decreases capacity choices only under the strong coordination treatment even if the market administrator does not undertake capacity coordination. A sharp contrast can also be observed

in the case of failure experience. The result of *td2.choice.no.sum* is insignificant, while the coefficient of *td3.choice.no.sum* is significant and positive, which implies that failure experience increases capacity choices under the weak coordination treatment. These results indicate the importance of deviation. Under the strong coordination treatment, subjects cannot deviate from the coordinated capacity. Therefore, there is no possibility of deviation when both subjects accept the suggestion by the market administrator. However, under the weak coordination treatment, subjects can deviate from the coordinated capacity in Stage 1 despite agreeing on capacity coordination at Stage 0. It is revealed that institutional/regulatory frameworks may significantly influence the behavior of market entrants even after the institution/regulation is removed. In the present setting, the effect of capacity coordination lingers after demand recovers and capacity coordination is removed, and the type of influence depends on the type of capacity coordination.

Result 4. *In the post-shock phase in which demand recovers and capacity is not coordinated, the effect of capacity coordination in the mid-shock phase lingers. The type of effect depends on the type of capacity coordination: (i) success of capacity coordination negatively influences capacity choices in the strong coordination treatment; (ii) failure of capacity coordination positively influences capacity choices in the weak coordination treatment.*

5. Surpluses

Whether capacity coordination should be allowed or strictly banned depends on whether this institutional framework increases welfare or achieves stability. Thus, finally, we examine social surpluses which is the sum of consumer surplus and profits of firms (payoffs subjects gain). Table 13 gives the average and the standard deviations of surpluses of markets. Moreover, Tables 14 and 15 give the results of comparisons between treatments by using the

Wilcoxon-Mann-Whitney (WMW) rank-sum test and F-test, respectively.

Combining these results, we can find several interesting points. First, let us focus on average surpluses. In the pre-shock phase, there are few differences between any two of the three treatments. However, clear differences are observed in the mid-shock phase. Social surplus under the strong coordination treatment is significantly smaller than social surpluses under the no and weak coordination treatments. The reason is that because capacity coordination works effectively under the strong coordination treatment, the profits of sellers are significantly larger under the strong coordination treatment than under other two treatments, while consumer surplus is significantly smaller. The latter negative effect in terms of social surplus dominates the former positive effect.

The situation in the post-shock phase, which is our main focus, is also interesting. The average surpluses of all treatments are different from each other. The numbers in Table 13 indicate that social surplus and consumer surplus under the weak (strong) coordination treatment is significantly greater (smaller) than other two treatments. This result is consistent with the results obtained in Sections 3 and 4. Capacities under the weak coordination treatment are likely to become large, which is influenced by experience of coordination failure. Thus, price competition becomes severe and, accordingly, consumer surplus becomes large.

Second, let us focus on standard deviations/variances. The result of F-test shows that variances of social surpluses of all three treatments are different from each other in all of three phases. In the mid-shock phase, social surplus under the strong coordination treatment is significantly more stable than the other two treatments. Although it is less stable than that in the no coordination treatment in the post-shock phase, it is still more stable than that under the weak coordination treatment. As far as social surplus is focused on, social surplus under the weak coordination treatment is less stable than social surpluses under the no and strong coordination treatments both in the mid- and post-shock phases. Consequently, it can be said

that the weak coordination treatment is not desirable in terms of stability of surpluses.

6. Conclusion

Conducting a laboratory experiment, we have investigated the effect of capacity coordination on firm behavior, such as choices of capacities and prices, by which the welfare effect can also be examined. In particular, we focus on the effect of capacity coordination in depression on the market and firm behavior in the periods after demand recovers (post-depression periods).

We conducted three treatments in terms of capacity coordination: no coordination, weak coordination, and strong coordination. The results of the experiment indicate that (i) strong coordination significantly reduces capacities during periods of demand shock vis-à-vis other coordination treatments and (ii) weak coordination is not effective. Moreover, we find that the experiences of success and failure of coordination influence subjects' capacity choices during periods after demand recovers even if capacity coordination is not allowed in those post-shock phase. In particular, the way of influence under the strong coordination treatment is sharp contrast with that under the weak coordination treatment. Experience of coordination negatively influences capacity choices in the post-shock phase under the strong coordination treatment, while experience of coordination failure positively influences capacity choices in the post-shock phase.

It is also important to note that this effect of experiences also affects the difference in social surpluses between treatments. Although subjects under all of the three treatments face the same condition in the post-shock phase, the average and standard deviation of social surpluses under any of two treatments are significantly different from each other.

Our experimental results indicate that the effect of capacity coordination lingers after demand recovers, and a type of rebound effect may exist, even if capacity coordination is not allowed in the periods after demand recovers. Thus, the authorities in charge of antitrust

immunity may have to take these effects into consideration carefully.

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Table1. Experimental Sessions

	Session ID	Date	Number of Subjects	Number of Markets	Rounds
No Cartel Coordination	1	10/6/2017	8	4	18
	2	10/20/2017	10	5	17
	3	10/21/2017	10	5	18
	4	10/28/2017	10	5	18
	5	11/10/2017	10	5	17
	6	11/11/2017	12	6	18
Strong Coordination	7	11/17/2017	10	5	18
(Treatment 2)	8	11/18/2017	10	5	18
	9	11/24/2017	8	4	18
	10	11/25/2017	12	6	18
	16	12/16/2017	12	6	18
	17	12/22/2017	10	5	17
Weak Coordination	11	12/1/2017	12	6	18
(Treatment 3)	12	12/2/2017	8	4	18
	13	12/8/2017	8	4	18
	14	12/9/2017	10	5	17
	15	12/15/2017	8	4	18

Table 2. Aerage Market Capacity and Sales in Each Treatment

CAPACITY

Round	No Coordination (Treatment 1)	Strong Coordination (Treatment 2)	Weak Coordination (Treatment 3)
1	148.429	156.742	171.619
2	173.429	181.774	175
3	189.393	190.677	207.381
4	198.964	208.129	220.762
5	209.643	215.935	222.143
6	221.464	219.71	215.905
7	**183.036**	**158.452**	**178.952**
8	**190.75**	**135.581**	**182**
9	**173.786**	**148.323**	**191.905**
10	**177.929**	**155.258**	**177.857**
11	**190.964**	**145.935**	**189.19**
12	**187.571**	**148**	**188.667**
13	206.286	202.613	216
14	204.643	204.774	218.952
15	211.75	202.129	217.571
16	206.107	200.065	225.524
17	214.857	202.161	224.714
18	212.4	202.577	230.25

SALES

Round	No Coordination (Treatment 1)	Strong Coordination (Treatment 2)	Weak Coordination (Treatment 3)
1	123.571	134.903	145.143
2	144.893	136.613	149.286
3	163.107	155.419	171.857
4	169.786	181.273	175.714
5	177.929	179.161	180.952
6	179.071	173.516	183.905
7	**144.107**	**130.71**	**140.952**
8	**152.929**	**123.636**	**148.762**
9	**146.393**	**134.161**	**155.905**
10	**150.25**	**130.774**	**153.381**
11	**158.857**	**130.806**	**152.143**
12	**160.679**	**132.548**	**156**
13	183.571	172.226	177.095
14	177.75	177.71	189.238
15	185.321	177.323	190.714
16	185.143	170	198.524
17	190.429	170	198.524
18	191.579	179.192	191.25

Round 1~6: 13~18

Monopoly 132, Cournot 176, Bertrand 264

Round 7~12

Monopoly 108, Cournot 144, Bertrand 216

Table 3. Aerage Price and Profits of Subjects in Each Treatment

PRICE

Round	No Coordination (Treatment 1)	Strong Coordination (Treatment 2)	Weak Coordination (Treatment 3)
1	39.464	36.097	34.143
2	37.589	34.667	34.405
3	32.393	33.79	28.857
4	30.286	30.403	29.643
5	30.571	29.177	28.904
6	28.857	30.145	27.667
7	**26.589**	**30.258**	**26.5**
8	**23.803**	**33.597**	**24.452**
9	**25.304**	**31.484**	**23.857**
10	**24.607**	**31.383**	**24.905**
11	**22.41**	**32.242**	**24.452**
12	**22.714**	**31.419**	**23.905**
13	27.714	30.645	29.357
14	29.161	30.113	27.143
15	28.071	29.839	26.833
16	28.143	30.048	25.619
17	27.089	28.581	26.119
18	27.184	29.577	26.813

Round 1~6: 13~18

Monopoly 43, Cournot 32, Bertrand 10

Round 7~12

Monopoly 37, Cournot 28, Bertrand 10

Profits

Round	No Coordination (Treatment 1)	Strong Coordination (Treatment 2)	Weak Coordination (Treatment 3)
1	1225.696	1413.581	1298.381
2	1292.482	1188.242	1382.714
3	1406	1377.468	1159.048
4	1323.196	1317.048	1117.0714
5	1413.964	1253.194	1225.024
6	1206.482	1150.484	1317.024
7	**721.643**	**991.0645**	**711.929**
8	**674.696**	**1268.774**	**711.929**
9	**809.929**	**1238.468**	**646.167**
10	**808.375**	**1092**	**758.929**
11	**670.714**	**1250.984**	**697.857**
12	**737.321**	**1217.229**	**691.857**
13	1354.268	1480.613	1182.952
14	1356.304	1394.371	1281.929
15	1354.339	1401.516	1279.976
16	1410.589	1370.919	1281.929
17	1346.071	1463.129	1219.357
18	1409.868	1492.269	1225.406

Round 1~6: 13~18

Monopoly 2178, Cournot 1936, Bertrand 0

Round 7~12

Monopoly 1458, Cournot 1296, Bertrand 0

Table 4. Standard Deviation of Market Capacity in Each Treatment

CAPACITY

Round	No Coordination (Treatment 1)	Strong Coordination (Treatment 2)	Weak Coordination (Treatment 3)
1	50.6152	72.951	66.425
2	75.049	80.027	72.115
3	74.718	71.024	98.038
4	72.151	78.589	108.121
5	67.174	76.443	98.64
6	78.922	89.357	78.14
7	**68.533**	**72.597**	**70.486**
8	**61.742**	**38.546**	**50.932**
9	**48.815**	**49.372**	**69.26**
10	**56.176**	**74.35**	**46.739**
11	**46.483**	**57.018**	**67.723**
12	**50.926**	**50.682**	**67.083**
13	54.415	72.463	53.492
14	57.502	68.391	66.016
15	59.297	67.086	47.713
16	56.913	55.706	51.055
17	53.727	49.172	47.49
18	48.524	52.68940924	72.628

Table 5. Wilcoxon Signed-ranks Test Results (P-values for two-sided tests)

CAPACITY

No Coordination (First 5 Rounds)

	R7~11	R13~17
R1~5	0.92	**3.86E-06**
R7~11		**1.35E-07**

No Coordination (Last Two Rounds)

	R11~12	R16~17
R5~6	**0.017**	0.679
R11~12		**0.006**

Strong Coordination (First 5 Rounds)

	R7~11	R13~17
R1~5	**3.97E-09**	**0.002**
R7~11		**1.97E-14**

Strong Coordination (Last Two Rounds

	R11~12	R16~17
R5~6	**6.32E-08**	0.72
R11~12		**1.66E-07**

Weak Coordination (First 5 Rounds)

	R7~11	R13~17
R1~5	0.56	**0.001**
R7~11		**2.67E-09**

Weak Coordination (Last Two Rounds)

	R11~12	R16~17
R5~6	0.088	0.115
R11~12		**5.77E-05**

Table 6. Wilcoxon Signed-ranks Test Results (P-values for two-sided tests)

SALES

No Coordination (First 5 Rounds)

	R7~11	R13~17
R1~5	0.176	**2.39E-09**
R7~11		**<2.2E-16**

No Coordination (Last Two Rounds)

	R11~12	R16~17
R5~6	**0.002**	0.087
R11~12		**1.38E-06**

Strong Coordination (First 5 Rounds)

	R7~11	R13~17
R1~5	**4.26E-09**	**5.75E-06**
R7~11		**<2.2E-16**

Strong Coordination (Last Two Rounds)

	R11~12	R16~17
R5~6	**1.42E-07**	0.665
R11~12		**2.77E-08**

Weak Coordination (First 5 Rounds)

	R7~11	R13~17
R1~5	**0.044**	**1.57E-06**
R7~11		**3.00E-13**

Weak Coordination (Last Two Rounds)

	R11~12	R16~17
R5~6	**1.20E-04**	**0.021**
R11~12		**5.45E-10**

Table 7. Wilcoxon-Mann-Whitney Rank-sum Test Results (P-values for two-sided tests)

CAPACITY

Phase 1 (R1~R6)

	Strong	Weak
No-coop	0.811	0.457
Strong		0.605

Phase 1 Last Two Rounds(R5~R6)

	Strong	Weak
No-coop	0.979	0.943
Strong		0.979

Phase 2 (R7~R12)

	Strong	Weak
No-coop	**2.39E-13**	0.988
Strong		**1.31E-09**

Phase 2 Last Two Rounds(R11~R12)

	Strong	Weak
No-coop	**1.13E-06**	0.578
Strong		**1.57E-04**

Phase 3 (R13~R18)

	Strong	Weak
No-coop	0.244	**0.006**
Strong		**6.07E-04**

Phase 3 Last Three Rounds(R16~R18)

	Strong	Weak
No-coop	0.357	**0.02**
Strong		**0.004**

Phase 1: Before-shock phase

Phase 2: Mid-shock phase

Phase 3: After-shock phase

Table 8. Wilcoxon-Mann-Whitney Rank-sum Test Results（P-values for two-sided tests）

SALES

Phase 1 (R1~R6)

	Strong	Weak
No-coop	0.879	0.231
Strong		0.164

Phase 1 Last Two Rounds(R5~R6)

	Strong	Weak
No-coop	0.762	0.66
Strong		0.476

Phase 2 (R7~R12)

	Strong	Weak
No-coop	**3.48E-10**	0.889
Strong		**5.56E-07**

Phase 2 Last Two Rounds(R11~R12)

	Strong	Weak
No-coop	**1.88E-05**	0.763
Strong		**0.005**

Phase 3 (R13~R18)

	Strong	Weak
No-coop	0.055	0.077
Strong		**0.001**

Phase 3 Last Three Rounds(R16~R18)

	Strong	Weak
No-coop	0.113	0.203
Strong		**0.005**

Phase 1: Before-shock phase

Phase 2: Mid-shock phase

Phase 3: After-shock phase

Table 9. Welch's T-test Results for Capacity (P-Values for two-sided tests)

CAPACITY

Phase 1 (R1~R6)

	Strong	Weak
No-coop	0.458	0.142
Strong		0.422

Phase 1 Last Two Rounds(R5~R6)

	Strong	Weak
No-coop	0.855	0.805
Strong		0.931

Phase 2 (R7~R12)

	Strong	Weak
No-coop	**3.40E-11**	0.9
Strong		**9.30E-10**

Phase 2 Last Two Rounds(R11~R12)

	Strong	Weak
No-coop	**7.30E-07**	0.973
Strong		**4.60E-05**

Phase 3 (R13~R18)

	Strong	Weak
No-coop	**2.03E-01**	0.053
Strong		**3.00E-03**

Phase 3 Last Three Rounds(R16~R18)

	Strong	Weak
No-coop	0.172	0.085
Strong		**0.004**

Phase 1: Before-shock phase

Phase 2: Mid-shock phase

Phase 3: After-shock phase

Table 10. Capacity and Cartel Choice in Round 7

Dependent Variable	Capacity	Cartel Choice	Cartel Choice
	OLS	Probit	Probit
Constant	-9.278	-0.775	-1.144*
	(-37.315)	(1.699)	(0.601)
risk	1.337	0.127*	0.130**
	(1.396)	(0.065)	(0.065)
sumpcapa	-0.078 *	-0.005**	-0.005**
	(0.042)	(0.002)	(0.002)
summcapa	0.104***	0.003**	0.003**
	(0.027)	(0.001)	(0.001)
sumearning	0.003	-0.000	
	(0.002)	(0.000)	
sumdearning	-0.002	-1.137E-04*	-1.234E-04**
	(0.001)	(6.506E-05)	(4.876E-05)
td2.cartel	-49.879***		
	(8.293)		
td3.cartel	-24.77**		
	(10.270)		
td2.choice.no	7.138		
	(12.255)		
td3.choice.no	-2.473		
	(12.983)		
t2dummy		0.030	0.033
		(0.270)	(0.270)
Observations	160	104	104
Adjusted/Pseudo R Square	0.274	0.105	0.106
F-statistic	16		
AIC		135.09	137.04

Note: *Significant at 10% level, **Significant at 5 %, ***Significant at 1% level.
Values in parentheses are standard errors.

Table 11. Capacity Choices in Mid-shock Phase

Dependent Variable	Capacity	Capacity	Capacity
Treatment	No coordination	Strong	Weak
Model	Fixed	Fixed	Fixed
Constant	68.823***	81.260***	88.865***
	(8.242)	(10.152)	(11.465)
prepcapa	0.238***	0.098	0.120
	(0.067)	(0.069)	(0.089)
predprice	0.046	-0.068	0.029
	(0.218)	(0.267)	(0.337)
preearning	0.002	0.001	-0.004
	(0.004)	(0.004)	(0.005)
cartel		-36.535***	-14.790**
		(4.790)	(5.953)
choice.no		-2.582	3.648
		(5.177)	(5.666)
Observations	280	310	210
R-square (within)	0.060	0.224	0.094
R-square (between)	0.194	0.416	0.458
R-square (overall)	0.118	0.289	0.268
F statistic	4.7	14.01	3.37

Note: *Significant at 10% level, **Significant at 5 %, ***Significant at 1% level.
Values in parentheses are standard errors.

Table 12. Capacity Choice in Round 13

Dependent Variable	Capacity
	OLS
Constant	21.264
	(17.740)
risk	-0.246
	(1.453)
sumpcapa.1	-0.090**
	(0.038)
summcapa.2	-0.136**
	(0.059)
summcapa.1	0.053**
	(0.021)
summcapa.2	0.135***
	(0.034)
td2.sumcartel	-6.886*
	(3.894)
td3.sumcartel	5.238
	(4.271)
td2.choice.no.sum	2.047
	(3.352)
td3.choice.no.sum	6.890**
	(3.470)
t2dummy	16.306
	(13.443)
t3dummy	-17.187
	(13.235)
Observations	160
Adjusted/Pseudo R Square	0.189
F-statistic	4.368

Note: *Significant at 10% level, **Significant at 5 %, ***Significant at 1% level.
Values in parentheses are standard errors.

Table 13. Average and Standard Deviation of Surpluses

Average

	Social Surplus			Profits			Consumer Surplus		
	No	**Strong**	**Weak**	**No**	**Strong**	**Weak**	**No**	**Strong**	**Weak**
Phase 1	6695.399	6635.241	6845.730	2625.702	2563.500	2496.921	4069.696	4071.741	4348.810
Phase 2	4787.060	4555.43	4714.651	1474.226	2323.99	1429.421	3312.833	2231.440	3285.230
Phase 3	7455.623	7265.600	7466.405	2747.063	2887.230	2500.600	4708.56	4378.370	4965.810

Standard Deviation

	Social Surplus			Profits			Consumer Surplus		
	No	**Strong**	**Weak**	**No**	**Strong**	**Weak**	**No**	**Strong**	**Weak**
Phase 1	1143.833	1274.601	1017.822	1327.546	1531.150	1603.936	1901.779	2015.678	1977.020
Phase 2	639.196	519.075	726.952	1085.552	1086.420	1014.171	1287.784	1266.78	1288.377
Phase 3	719.649	825.219	930.914	1271.445	1265.500	1233.497	1652.129	1756.26	1483.976

Table 14. Wilcoxon-Mann-Whitney Rank-sum Test Results (P-values for two-sided tests)

Phase 1 Social Surplus

	Strong	Weak
No-coop	0.492	0.211
Strong		0.090

Phase 1 Profits

	Strong	Weak
No-coop	0.925	0.757
Strong		0.516

Phase 1 Consumer Surplus

	Strong	Weak
No-coop	0.857	0.116
Strong		0.056

Phase 2 Social Surplus

	Strong	Weak
No-coop	**0.000**	0.588
Strong		**0.000**

Phase 2 Profits

	Strong	Weak
No-coop	**0.000**	0.339
Strong		**0.000**

Phase 2 Consumer Surplus

	Strong	Weak
No-coop	**0.000**	0.854
Strong		**0.000**

Phase 3 Social Surplus

	Strong	Weak
No-coop	**0.003**	**0.040**
Strong		**0.000**

Phase 3 Profits

	Strong	Weak
No-coop	0.075	**0.001**
Strong		**0.000**

Phase 3 Consumer Surplus

	Strong	Weak
No-coop	**0.034**	**0.022**
Strong		**0.000**

Phase 1: Pre-shock phase

Phase 2: Mid-shock phase

Phase 3: Post-shock phase

Table 15. F test to Compare Variances (P-values for two-sided tests)

Phase 1 Social Surplus

	Strong	Weak
No-coop	**0.046**	0.050
Strong		**0.000**

Phase 1 Profits

	Strong	Weak
No-coop	**0.009**	**0.001**
Strong		0.424

Phase 1 Consumer Surplus

	Strong	Weak
No-coop	0.284	0.507
Strong		0.746

Phase 2 Social Surplus

	Strong	Weak
No-coop	**0.000**	**0.028**
Strong		**0.000**

Phase 2 Profits

	Strong	Weak
No-coop	0.989	0.254
Strong		0.245

Phase 2 Consumer Surplus

	Strong	Weak
No-coop	0.761	0.989
Strong		0.768

Phase 3 Social Surplus

	Strong	Weak
No-coop	**0.013**	**0.000**
Strong		**0.042**

Phase 3 Profits

	Strong	Weak
No-coop	0.931	0.621
Strong		0.673

Phase 3 Consumer Surplus

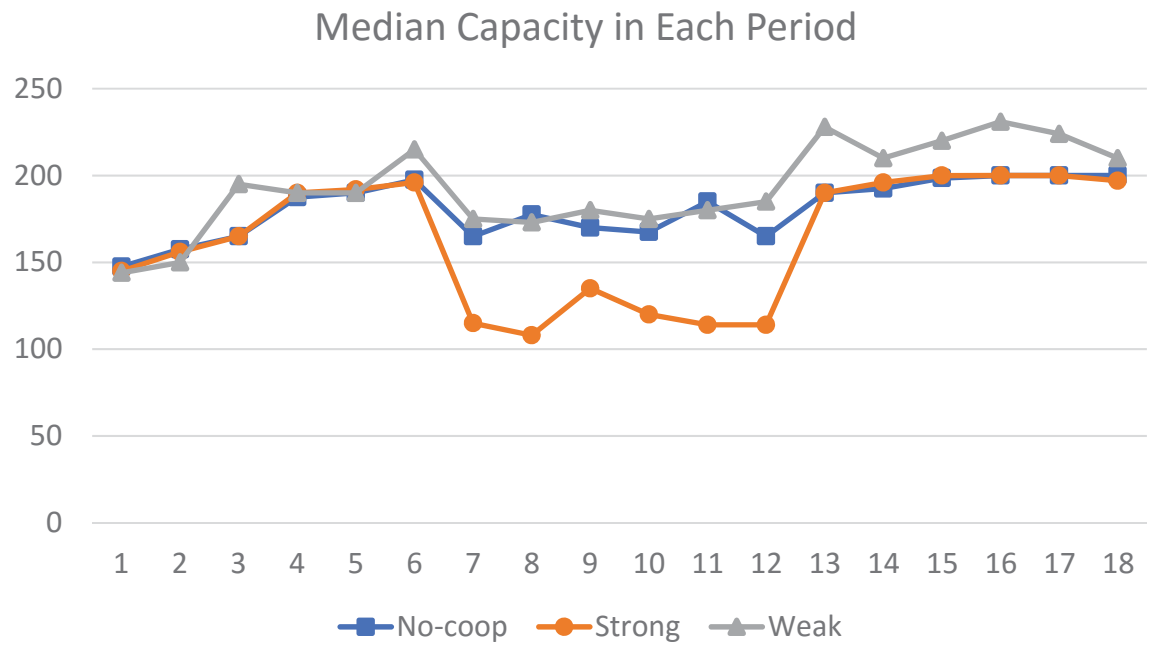
	Strong	Weak
No-coop	0.271	0.079
Strong		**0.005**

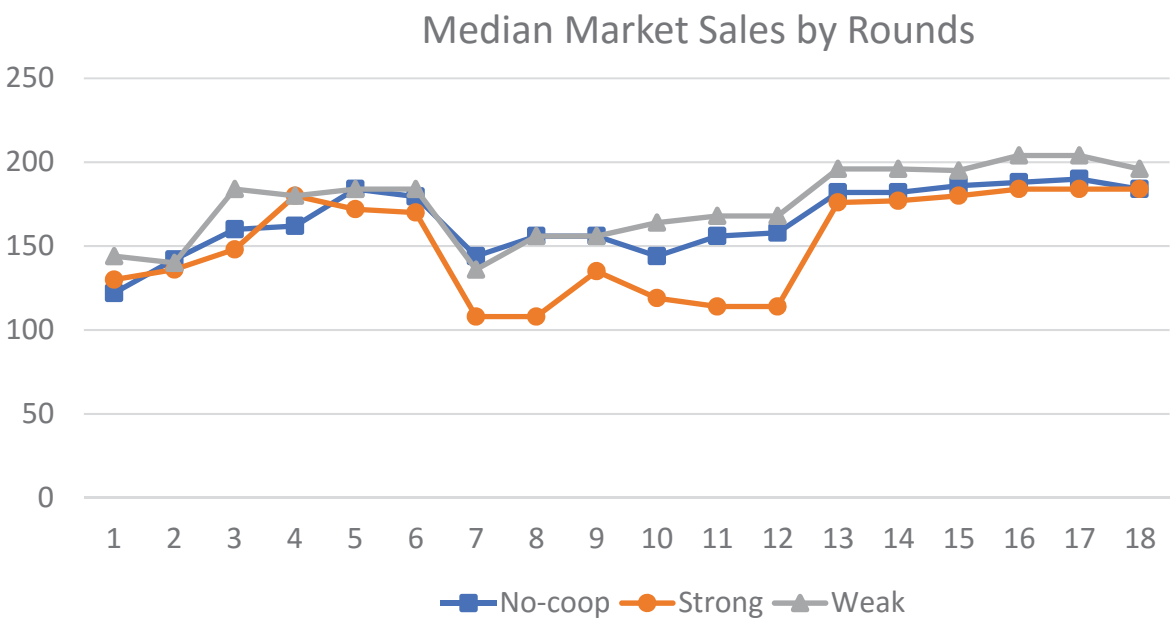
Phase 1: Pre-shock phase

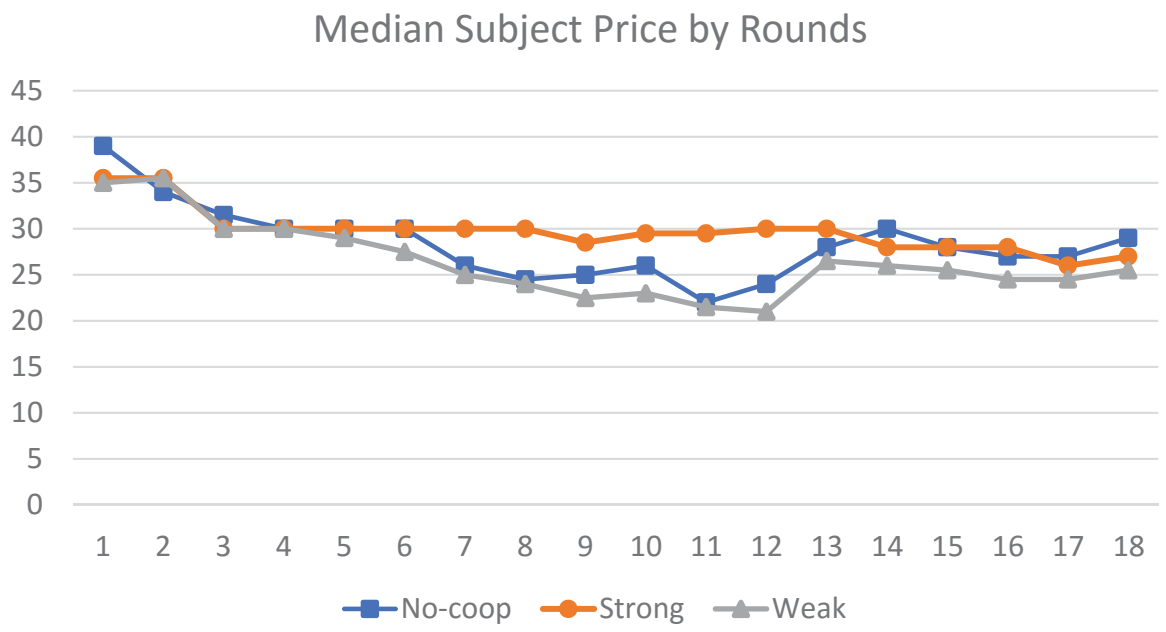
Phase 2: Mid-shock phase

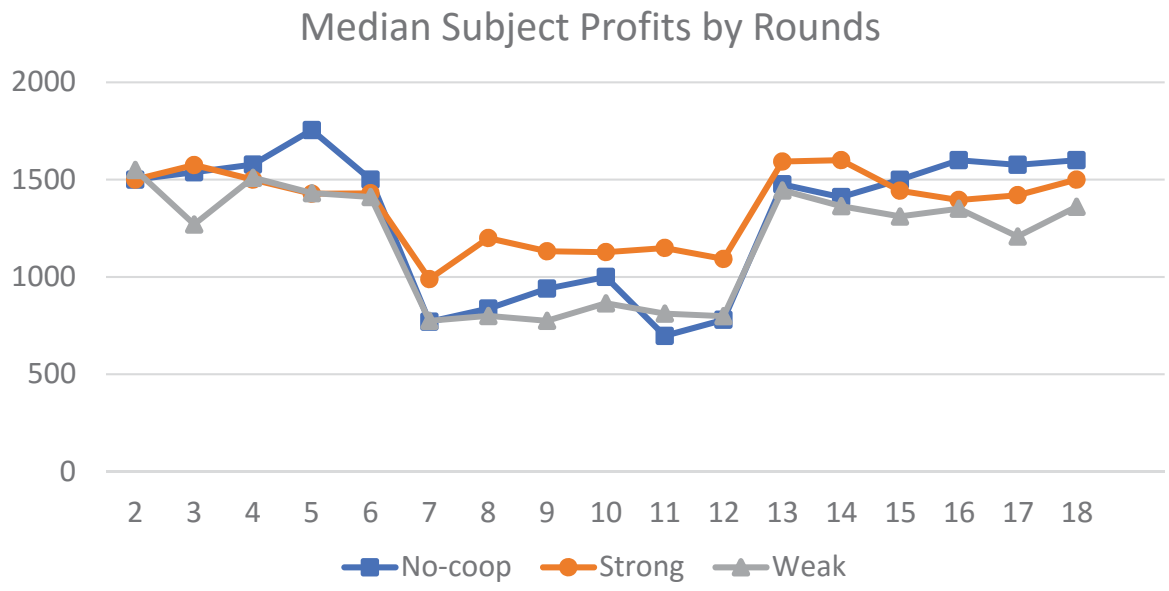
Phase 3: Post-shock phase

Figure 1. Median Capacities, Sales, Prices, and Profits






Median Subject Price by Rounds
45
40
35
30
25
20
15
10
5
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
No-coop
Strong
Weak


Median Subject Profits by Rounds
2000
1500
1000
500
0
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
No-coop
Strong
Weak