Value co-creation and Value capture in Strategic Partnerships: An Experimental Study on Coopetition

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Abstract

Many inter-organizational and intra-organizational activities involve both cooperation and competition: economic agents cooperate to use their complementary resources to create value but at the same time compete for the created value. Such coopetition status is salient in innovation-related partnership, in which partners cooperate on co-creating technological and marketing knowledge, while at the same time competing on learning and internalizing more from partners critical resources. Based on the assumption that firms and individuals have resource constraints, how to balance cooperation and competition within a strategic partnership, and how economic agents interact with each other, receive attention from both academia and practice. In this paper, we model coopetition as the interaction between two players to study this tension between value creation and value appropriation both theoretically and experimentally. Consistent with the analysis, when there is competition for existing values, players invest more in value appropriation and less in value creation. We find that individuals are conditional cooperators: players adjust their allocation of resources in the direction matching their opponents’ investment level in the previous round. Initial experience has shown to have a significant influence on strategic partnerships: relationships that successfully establish trust at the start are likely to sustain high cooperation level and achieve the efficient outcome even after the market condition has changed. This research is a first attempt to model coopetition and to investigate the interplay of cooperation and competition using the experimental method. Besides managerial implications, this study contributes to the literature on strategic decision making and coopetition.
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ABSTRACT

Many inter-organizational and intra-organizational activities involve both cooperation and competition: economic agents cooperate to use their complementary resources to create value but at the same time compete for the created value. Such coopetition status is salient in innovation-related partnership, in which partners cooperate on co-creating technological and marketing knowledge, while at the same time competing on learning and internalizing more from partners critical resources. Based on the assumption that firms and individuals have resource constraints, how to balance cooperation and competition within a strategic partnership, and how economic agents interact with each other, receive attention from both academia and practice. In this paper, we model coopetition as the interaction between two players to study this tension between value creation and value appropriation both theoretically and experimentally. Consistent with the analysis, when there is competition for existing values, players invest more in value appropriation and less in value creation. We find that individuals are conditional cooperators: players adjust their allocation of resources in the direction matching their opponents’ investment level in the previous round. Initial experience has shown to have a significant influence on strategic partnerships: relationships that successfully establish trust at the start are likely to sustain high cooperation level and achieve the efficient outcome even after the market condition has changed. This research is a first attempt to model coopetition and to investigate the interplay of cooperation and competition using the experimental method. Besides managerial implications, this study contributes to the literature on strategic decision making and coopetition.

Keywords: competition; cooperation; coopetition; value creation; value appropriation; strategy partnerships; online experiment;
1. Introduction

A fundamental question that firms face is how to allocate limited resources between value creation and value appropriation to maintain competitive advantage (Mizik & Jacobson, 2003). This tension is especially salient in strategic partnerships between firms. In strategic partnerships, firms with complementary resources cooperate to create a larger pie, but at the same time compete on appropriating a larger slice of the pie. This coexistence of cooperation and competition is called coopetition in the management literature (Brandenburger & Nalebuff, 1996). Coopetition occurs when companies interact with partial congruence of interests (Dagnino, 2002).

Firms, based on complementarity and common objectives, often form strategic partnerships to enlarge market share, create new knowledge, stimulate innovation, and improve financial performances. Extant literature suggests that partnering firms can gain relational competitive advantage and relational rents through trustful relationships, shared resources and knowledge that cannot be earned individually (Dyer & Singh, 1998). Based on a harmonious win-win assumption, a focal firm’s value capture/appropriation from a partnership receives less attention compared to value co-creation and is usually taken granted. When involved in a partnership, a focal firm may face a paradoxical situation termed as coopetition, i.e. simultaneous cooperation and competition (Brandenburger & Stuart, 1996). Partnering firms need to cooperate to co-create a larger pie and compete with each other to capture a larger share of the pie, whether they are in a vertical partnership as suppliers and customers or a horizontal partnership as rivals (Bengtsson & Kock, 2014; Lea Stadtler; Luk N.Van Wassenhove, 2016; Raza-Ullah, Bengtsson, & Kock, 2014).

Several conceptual researches suggest that a syncretic strategy that exhibits both high levels of cooperation and competition leads to higher economic growth and technological progress (A.A. Lado, N.G. Boyd, 1997; Bengtsson & Kock, 2014; Raza-Ullah et al., 2014; Ritala & Hurmelinna-Laukkanen, 2009). However, coopetition in nature is about the dualism and dynamics between two
contradictory logics. Cooperation under the context of strategic partnership requires resource investment, knowledge sharing and trust between partnering firms. While competition over the co-created value depends on a focal firm’s bargaining power, absorptive capacity, and opportunistic behaviors relative to its partners (Bengtsson, Raza-Ullah, & Vanyushyn, 2016; Lavie, 2000; Teece, 1992). Such dualism persists at individual, team, firm, inter-firm and network levels, and is associated with the entire process of a collaborative project or a partnership (Baruch & Lin, 2012; Bengtsson et al., 2016; Hamel, 1991; X. Luo, Slotegraaf, & Pan, 2006; Y. Luo, 2004; Shahzad Ansari, Raghu Garud, 2016).

In order to pursue the coopetition synergy, many scholars propose a separation mechanism to balance cooperation and competition. For instance, creating a time lag between value co-creation and value capture can separate cooperation and competition intertemporal, while a structural separate can take the form of cooperating on one business while competing on others. Yet such separation mechanism ignores the inherent relatedness and potential synergy between cooperation and competition (Bengtsson & Kock, 2000; Lea Stadtler; Luk N.Van Wassenhove, 2016). More importantly, it is not easy to separate cooperation and competition as they simultaneously co-exist and embed in each individual.

Previous empirical coopetition studies usually adopt case studies or quantitative analysis based on survey data. These research designs are based on ex-post data collection and can hardly capture each individual’s subtle and paradoxical coopetition mindsets and behaviors. Further, when conceptualizing coopetition and empirically investigating how coopetition influences a focal firm’s performance, existing literature usually overlooks how the partner’s decision on cooperation and competition dynamically influences the focal party’s strategies.

This current research takes a dyadic strategic partnership as the research context, and investigates the following research question: What are the dynamics of cooperation and competition
between the two parties towards value co-creation and value capture? A major difficulty in coopetition research is how to obtain data on the paradoxical individual mindset when involved in a coopetitive status. An experimental research design is adopted to answer this question. The research design helps to show the dynamics of cooperation and competition at the individual level, and it captures how an individual’s decision making is influenced by its partner. The experimental data show that individuals are conditional cooperators: players adjust their allocation of resources in the direction matching their opponents’ investment level in the previous round. Initial experience has shown to have a significant influence on strategic partnerships: relationships that successfully establish trust at the start are likely to sustain high cooperation level and achieve the efficient outcome even after the market condition has changed. A key to the success of strategic partnerships is to establish trust at the beginning.

This research scientifically contributes to the literature of coopetition. It is one of the first attempts to use experiment method to investigate coopetition from the value co-creation and value capture perspective. This research also contributes to management practices how firms and individuals can strategize when get involved in coopetitive situation.

The rest of the paper is organized as follows: Section 2 introduces existing literature on relevant to coopetition, value co-creation and capture; Section 3 introduces the theoretical model of coopetition and Section 4 describes the experiment; Section 5 presents the research findings and followed by a conclusion in Section 6.

2. Literature

2.1 Theoretical Background of Coopetition

The concept of coopetition is informed by theoretical streams such as transaction cost economics, resource-based approach, and game theory.
Transaction cost economics proposes three generic forms of economic organization, i.e. market, hybrid, and hierarchy. Firms and individuals choose how to transact and how to determine organizational boundaries based on the purpose of minimizing the sum of production and transaction costs (Kogut, 1988; Williamson, 1991). Markets fail to transact tacit knowledge due to their specificity, low codifiability, low mobility, and difficulties on valuation, thus establishing partnership can help firms lower transaction costs, access others’ tacit knowledge, while remaining autonomous (Quintana-García & Benavides-Velasco, 2004). Unlike the two polar forms, market and hierarchy, hybrid forms such as strategic partnerships and joint ventures fulfill individual interests while covers bilateral objectives. Transaction cost economics assumes that human beings are often opportunistic and hence pursue own interests at the expense of others (Williamson, 1991). The party with stronger opportunistic behaviors may benefit more from a partnership, and severe opportunist behaviors and conflict interests may fail a partnership (Lavie, 2000). As individual and common interests are usually “partially congruence”, the entanglement of cooperation (fulfilling common goals) and competition (pursuing individual interests) becomes the nature of a partnership (Padula & Dagnino, 2007), which causes the instability of a strategic partnership (Das & Teng, 2000b). Hence, in the long-run, a strategic partnership may evolve towards hierarchy such as vertical integration and horizontal mergers & acquisitions, or dissolve and follow market governance (Das & Teng, 2000b).

Resource-based view suggests that a focal firm can earn economic rent and competitive advantage through valuable, rare, inimitable and nonsubstitutable resources (Barney, 1991). Yet, a firm’s critical resources may locate beyond its organizational boundaries. Firms may get involved in strategic partnership when they own resources featured by imperfect mobility, imperfect imitability, and imperfect substitutability, such as knowledge resources (Das & Teng, 2000c). Besides the rationale of lowering transaction costs, resource-based view highlights the value co-
creation potential of pooled resources. Further, partnering firms can gain a relational competitive advantage that cannot be earned individually (Dyer & Singh, 1998; Lavie, 2000)(Das & Teng, 2000a). While strategic partnerships provide a focal with opportunities to access and internalize its partner’s critical resources that can hardly be cultivated internally and purchased in markets. Hence, there is a hidden learning race between agents involved in a partnership (Hamel, 1991b). Due to the different endowment and capabilities, the party with stronger absorptive capacity, higher bargaining power, and more salient opportunistic behaviors may appropriate a larger share of the co-created value (Lavie, 2000). That is to say, a focal agent contributes a lot on value co-creation within a partnership, while most of the co-created value may be acquired by its partner (Hoffmann, Lavie, Reuer, & Shipilov, 2018; Lepak et al., 2016). Given the status that every agent has resource constraint, firms or individuals need to balance the resources invested on cooperating on value co-creation and competition on value appropriation (Mizik & Robert Jacobson, 2003), and how to strategize on that trade-off receives more and more attention these years (Hannah & Eisenhardt, 2018; Hoffmann et al., 2018; Teece, 1992).

A third theoretical stream is game theory. The concept of coopetition in 1996 is proposed by Brandenburger and Stuart, referring to a revolutionary mindset and business strategy that integrates cooperation and competition (Brandenburger & Stuart, 1996; Lea Stadtler; Luk N.Van Wassenhove, 2016). No business can act in isolation. Firms and agents are involved in what is termed as value chains or value networks (Gereffi, Humphrey, & Sturgeon, 2005) to expand existing markets or create new ones. Based on cooperative behaviors such as relational resource investment, knowledge sharing, trust, and reciprocity, agents co-create value. However, one value creator gains little from a partnership, as the majority of the co-created pie is captured and spilled to its partner, could be customers, suppliers, or complementors, capture (Lepak et al., 2016). Coopetition strategy is about value creation and value capture, and its fundamental assumption is the dualism and

2.2 Research Status on Coopetition in Strategic Partnerships

Following the coopetition perspective, firms cooperate on value creation while compete on value capture. During the past two decades, efforts have been made to enhance our understandings on the rationale and mechanisms of coopetition, and how coopetition influences value co-creation and value capture.

Vertical partnership between upstream suppliers and downstream customers is quite common, as the partnering parties in nature are complementary and are not involved in direct competition with each other. A large number of studies have shown that partnering with customers and suppliers can enhance the focal firm’s technological and financial performances. While a less intuitive but also common phenomenon is the partnership between rivals, i.e. firms offer similar products or services at the same market segment.

Researchers have noticed this tricky issue and come up with different answers. Some suggest that competing firms have profound knowledge on certain technologies and market segments, thus partnering rivals can develop new or even radical products through joint innovation projects or enlarge market scale by pooling resources together. Through cooperating with rivals, innovation is generated and a focal firm’s technological and financial performances will be improved (Belderbos, Carree, & Lokshin, 2004; Gnyawali & Park, 2011; Peng, Pike, & Yang, 2012; Ritala & Hurmelinna-Laukkanen, 2013)(Soriano, Tierno, & Tur, 2016). A famous example is the joint venture between Samsung and Sony on S-LCD flat screen development, which benefited both parties in terms of technological and market performances (Gnyawali & Park, 2011). While some other studies offer different findings, and suggest that cooperating with rivals doesn’t stimulate innovation novelty and product innovation (Mention, 2011)(Nieto & Santamaría, 2007). Besides,
when partnering with rivals, a focal firm’s financial and technological performances may be affected by many issues, such as market uncertainty, industrial structure and competition intensity, and network externalities (Ritala, 2012).

As aforementioned, coopetition refers to a status that cooperation and competition co-exist interdependently, even though some scholars merely define coopetition as cooperate with competitors (e.g. (Ritala & Hurmelinna-Laukkanen, 2009)(Ritala, 2012)). Competition also resides in vertical partnership between suppliers and customers, when it comes to value capture that aims at maximizing own benefits. While what determines a focal firm’s value capture within a partnership? Existing literature has suggested a series of factors that influence value capture. Usually, a focal firm with relatively higher bargaining power will capture more value from the co-created pie. Such bargaining power may come from an asymmetric status that a focal firm invests more valuable and important resources to the partnership, or holds a more competitive position in the current market compared to its partner. In other words, if the partner needs the focal firm more than the other way around, the focal firm has more bargaining power. Moreover, a strategic partnership, especially those aim at innovation, involves knowledge resource investment and sharing. Besides getting a share of the co-created pie, a focal firm can also benefit from learning and capturing partners’ knowledge spillovers during the entire process of the partnership. That is to say, a strategic partnership also involves a learning race between the cooperating parties (Hamel, 1991a). Due to the inevitable knowledge spillover, a focal firm can capture value from both co-invested resources and partner’s non-shared resources (Lavie, 2000). A firm with higher absorptive capacity and learning capabilities, and more salient opportunistic behavior relative to its partner can therefore capture more value from the partnership (Lavie, 2000). Thus, competition on value capture doesn’t merely happen after the pie is co-created, but start already at the beginning of the partnership, and exist during the whole process of the partnership.
A partnership is coopetitive in nature and involves both cooperation and competition simultaneously during the entire process of value creation and capture. Intensive intra-partnership rivalry within a partnership, shown as opportunistic hazards that firms focus solely on maximizing own benefits rather than sharing knowledge and commit resources with partner, may lead to partnership failure (Park & Ungson, 2001). Further, besides intra-partnership rivalry on value capture, competition outside of an agreement between partners may also affect the partnership and even deteriorate a partnership (Park & Russo, 1996).

From the above discussions, we can see that cooperation and competition mutually influence on each other within a partnership, and the dynamics between cooperation and competition may influence on the size of the co-created pie as well as individual share of the pie. Then, how should partnering firms pursue a benign interaction between cooperation and competition? Previous studies have given several answers. Some suggest firms should eliminate competition within a partnership or avoid cooperating with competitors (Das & Teng, 2000a; Ireland, Hitt, & Vaidyanath, 2002; Tjosvold & Wong, 1994). Yet this argument is based on the assumption that cooperation and competition are mutually exclusive, thus neglects the syncretic nature of coopetition that involves both high levels of cooperation and competition (A.A. Lado, N.G. Boyd, 1997; Bengtsson & Raza-Ullah, 2016). Some others suggest a structural or temporal separation mechanism (Wojciech Czakon, Karolina Mucha-Kuś, 2010). Certain departments or divisions of firms can cooperate on new product or market development, while other parts of the firms compete intensively. Besides, partnering firms can also create a time lag between cooperation on value co-creation and competition on individual value capture. However, as discussed before, as cooperation and competition co-exist during the entire process of a partnership, it is not easy to separate cooperation and competition completely. Besides, coopetition after all is an individual paradoxical mindset, e.g. when involved in a strategic partnership that involves learning and knowledge sharing, one may
always try to learn more from his partner while worry own core knowledge being leaked. Thus existing efforts on investigating coopetition remain insufficient (M. Chen, 2008b; M. Chen & Miller, 2015), and the interplays between cooperation and competition within a partnership remain unclear.

3. The Model of Coopetition

Two firms, each with resources \( n \), compete in a market with value \( A \). Firms can their complementary resources to expand the market. The main questions the firms face is how to allocate their resources into value creation and value appropriation. For firm \( i \) \( (i = 1,2) \), denote \( x_i \) as the investment in value creation, \( y_i \) as the investment in value appropriation, \( z_i \) as the investment to some outside investment options that are not influenced by the partner’s behaviors. We use the creation function \( C(x_1, x_2) \) to represent the value co-created by two firms and use the appropriation function \( p(y_1, y_2) \) to represent the share of the total market value. Without loss of generality, we assume that investment to outside options \( z_i \) leads to a return of \( z_i \), that is, each unit of resources invested into the outside option leads to a payoff of 1.

Because of the complementarity of two firms’ resources, \( C(x_1, x_2) \) is a convex function of \( x_1 \) and \( x_2 \). Firm \( i \)’s market share of the total market value \( p(y_1, y_2) \) is increasing in \( y_1 \) and decreasing in \( y_2 \). Firm \( i \)’s payoff function can be represented as follows:

\[
\pi_i = p(y_1, y_2)[C(x_1, x_2) + A] + z_i
\]

In this paper, we focus on the case where strong complementarity exists between two firms, so the creation function is the product of two firms’ creation investment: \( C(x_1, x_2) = x_1 x_2 \). The share of a firm’s appropriation investment determines its share of the market value—in other words \( p(y_1, y_2) = \frac{y_1}{y_1 + y_2} \). A firm’s goal is therefore to solve the following optimization problem:

\[
\max_{x_i, y_i, z_i} \pi_i = \frac{y_i}{y_1 + y_2} (x_1 x_2 + A) + z_i
\]
s.t. \[ x_i + y_i + z_i \leq n, \]
\[ x_i \geq 0, y_i \geq 0, z_i \geq 0. \]

The coexistence of value creation and value appropriation has great resemblance with the model of conflict in the economics literature (Hirshleifer, 1991; Skaperdas, 1992). There are, however, several key differences. First, in models of conflict, the creation function \( C(x_1, x_2) \) is a linear or concave function of two firms’ investments, reflecting non-increasing return to scale. In contrast, we have a convex function in order to reflect the synergy generate by two firms’ complementary resources. Second, the appropriation function \( p(y_1, y_2) \) represents the probability of acquiring all the existing value, so the realization of the payoff is probabilistic. In the coopetition model, \( p(y_1, y_2) \) is a deterministic number representing the share of the existing value. In addition, firms in the coopetition model can choose to invest all their resources into outside options without having any interaction with the other firm, whereas in a model of conflict the two parties must invest all their resources into value creation and/or value appropriation without any outside options.

To solve for the optimal solution, check the first order condition:

\[ \mathcal{L}(x_i, y_i) = \frac{y_i}{y_1 + y_2} (x_1x_2 + A) + (n - x_i - y_i) + \lambda_{i1}x_i + \lambda_{i2}y_i + \lambda_{i3}(n - x_i - y_i) \]

The first order conditions:

\[ \frac{\partial \mathcal{L}(x_i, y_i)}{\partial x_i} = \frac{y_i}{y_1 + y_2} x_{-i} - 1 + \lambda_{i1} - \lambda_{i3} = 0 \]

\[ \frac{\partial \mathcal{L}(x_i, y_i)}{\partial y_i} = (x_1x_2 + A) \frac{y_{-i}}{(y_1 + y_2)^2} - 1 + \lambda_{i2} - \lambda_{i3} = 0 \]

\[ x_i \geq 0, \lambda_{i1} \geq 0, \lambda_{i1}x_i = 0 \]

\[ y_i \geq 0, \lambda_{i2} \geq 0, \lambda_{i2}y_i = 0 \]

\[ n - x_i - y_i \geq 0, \lambda_{i3} \geq 0, \lambda_{i3}(n - x_i - y_i) = 0 \]
When the existing market value $A$ is small, there are two equilibrium: in one equilibrium, firms keep all their resources for the outside options and do not have coopetitive relationships ($x_i = y_i = 0, z_i = n$); in the other equilibrium, firms allocate their resources between creation and appropriation ($z_i = 0$). When $A$ is sufficiently large, the only equilibrium is a coopetitive equilibrium ($z_i = 0$).

4. The Experiment

4.1 Design and Procedure

Our main goal of the experiment is to investigate how existing market value influence coopetition. We focus on two values of $A$: 0 and 60. When $A=0$, the two firms do not have any overlapping market or existing competition, but they have the opportunity to cooperate to generate market values. When $A=60$, the two firms have competition in the existing market. In order to investigate whether previous experience influence future interactions, we implement an A-B design. Two participants are paired together and interact for 20 rounds. The 20 rounds are divided into two parts. With a different value of $A$, each part lasts 10 rounds. In treatment A0_60, A is 0 for Part 1 and 60 for Part 2; in treatment A60_0, A is 60 for Part 1 and 0 for Part 2. Participants can only choose integers for the allocation of resources. An overview of the experimental treatments is shown in Table 1.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Existing market value A</th>
<th>Number of subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0_60</td>
<td>0</td>
<td>60</td>
</tr>
<tr>
<td>A60_0</td>
<td>60</td>
<td>0</td>
</tr>
</tbody>
</table>
Subjects were recruited from the Amazon Mechanical Turk labor market ("MTurk") and randomly assigned subjects to a treatment. MTurk has a large population and makes it possible to recruit a large number of human participants through the experiment with strong incentives, and it has been widely used to recruit subjects for social science experiments (Arechar, Gächter, & Molleman, 2018; Beranek, Cubitt, & Gächter, 2015; Goodman, Cryder, & Cheema, 2013; Horton, Rand, & Zeckhauser, 2011; Mason & Suri, 2012; Rand, 2012). Researchers can post Human Intelligence Tasks (HITs) on MTurk as requesters and invite MTurk workers to complete these HITs. After a HIT is submitted, the requester can decide whether to approve it or not. If the HIT is approved, the worker will receive the corresponding payment specified on the HIT post.

In our experiment, participants were restricted to MTurk workers located in the U.S., who had completed more than 100 HITs with an approval rate at least 90%. Participants were told that they would earn a base payment of 1 dollar ($1.00) plus the possibility for a substantial bonus, depending on decisions they and the other participants they are paired with make within the game. After reading the basic information of the experiment and providing informed consent, subjects can accept the HIT and participate in the experiment. The experiment was programmed using oTree (D. L. Chen, Schonger, & Wickens, 2016). Instructions of Part 1 of the experiment were shown on the screen, and participants could go through the instructions at their own pace. Subjects were informed that the experiment consisted multiple parts, but they did not know the content and format of Part 2.

To make sure the participants understand how the game works, they had to answer a set of quiz questions in order to be able to participate in the experiment. If a participant passed the quiz, he was put into a waiting room. If there was another participant in the waiting room, they were matched, and the interaction started. If no other participants were in the waiting room, the participant would wait for another one to arrive. If no one arrived in 3 minutes, the participant could choose to exit the experiment with only the base payment of $1, or choose to wait further.
In each round of the interaction, the subjects had 1 minute to submit their decisions in the first 5 rounds and 30 seconds for the rest of the experiment. If they did not reach their decisions in the allocated time, a random decision would be made for them and they would not receive the payment for that round. The average time spent for each round is about 10 seconds, much less than the 30 second limit. Random decisions occurred very rarely (0.005) and mainly on a small number of subjects.

The experiment lasted approximately 25 minutes with average earnings $4.55 (ranged from $3.02 to $8.74). The effective average hourly payment was more than $10, a relatively high compensation rate for M-Turk workers. The two treatments were conducted around the same time in order to avoid potential demographic differences caused by the hours of the day and/or the days of the week.

4.2 Theoretical analysis

It is easy to see that in all treatments, the efficient outcome is to invest all resources in value creation, that is, (x,y) = (0,10). However, this efficient outcome is not an equilibrium because firms always have the incentive to increase their appropriation investment in order to obtain a larger share of the value.

Game-theoretical analysis shows that when A=60, there is a unique equilibrium (x,y) = (0,10), that is, firms keep all their resources for outside options without any value co-creation. This is the case where firms have competition over a relatively large existing market. Investing more in value creation meaning fewer resources available to compete for the existing market value, so firms would be cautious in creation investment. When A=0, on the other hand, firms do not have competition in the existing market, and their complementary resources can generate a lucrative value, so investment in value creation can be profitable as long as they still keep enough resources
for appropriation. However, value creation is possible only when both firms are willing to invest. If one firm does not have value investment, the other firm’s investment would go wasted. Therefore, no existing competition does not guarantee that value co-creation will happen. Both firms invest all their resources in outside options is another equilibrium. Table 2 shows the equilibrium analysis for different values of A.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No coopetition</th>
<th>With coopetition</th>
<th>Efficient outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>A0</td>
<td>(0, 0)</td>
<td>(7, 3)</td>
<td>(10, 0)</td>
</tr>
<tr>
<td>A60</td>
<td>(0,10)</td>
<td>-</td>
<td>(10, 0)</td>
</tr>
</tbody>
</table>

For the rest of this paper, we use A60I and A0II to represent Part I and Part II of the treatment A60_0 respectively and use A0I and A60II to represent Part I and Part II of the treatment A0_60. The equilibrium analysis clearly shows that appropriation investment is higher in A60 than A0: while appropriation investment is 10 in A60, it must be less than 3 in A0. Our first hypothesis is on the level of appropriation investment. To avoid order effect and behavioral spillover, this comparison is focused on the first part of the experiment.

**Hypothesis 1** Appropriation investment is higher in A60I than A0I.

Because of the multiple equilibrium in A0, a definite prediction on the difference in creation investment cannot be provided because in both A0 and A60, \( x = 0 \) is an equilibrium. However, because \( (x,y) = (7,3) \) is another equilibrium in A0, it is likely that some players will try to make positive investment, so we conjecture that investment in value creation is higher in A0 than A60 in Part 1 of the experiment.

**Hypothesis 2** Creation investment is higher in A0I than A60I.
The above two hypotheses are derived from equilibrium analysis. Experiments have shown that cooperation in social dilemmas is significantly higher than equilibrium prediction. It is likely that in the coopetition games value creation is significantly higher than equilibrium level. However, the above hypotheses are still valid based on comparative statics analysis.

Another focus of our experiment is on behavioral spillovers. Previous studies have shown that behaviors in one game can spillover to a different game played later. For example, successful coordination on the efficient outcome has been show to significantly increase cooperation in social dilemmas played later (Knez & Camerer, 2000) and coordination in the minimum effort games (Cason, Savikhin, & Sheremeta, 2012; Weber, 2006), while high conflict level in the payment scheme in one task has a detrimental effect on cooperation in the public goods game followed (Buser & Dreber, 2015). In our experiment, we conjecture than experience with A0I is likely to make the average creation investments in A60II higher than A60I, because of the relatively high creation in A0I. Similarly, the average appropriation investments in A0II is higher than A0I because of the previous experience in the high conflict environment in A60I:

**Hypothesis 3:** Creation investments are higher in A60II than in A60I; appropriation investments are higher in A0II than in A0I.

Similarly, we can investigate behavioral spillovers on the individual or pair level: if partners successfully maintain high value creation and low conflict in one market condition, those behaviors will spillover to a different market condition.

**Hypothesis 4** Pairs of players with high cooperation/conflict in Part 1 of the experiment are more likely to have high cooperation/conflict even after the market condition has changed in Part 2.
5. Results

We decided to categorize a subject as was timed out more than twice, we categorized him as not 120 subjects passed the quiz and were successfully paired with another subject. Recalled that a random allocation would be made for a subject if he was not able to reach a decision within the specified time. In order to avoid the confounding effect of random allocations, all the subjects who were timed out more than twice and their partners were excluded from the analysis, leaving us 52 subjects in each treatment. In the analysis, random decisions were also excluded from the analysis.

5.1 Value creation and value appropriation on the aggregate level

Figure 1 shows the distributions of resource allocations over time in both treatments. Dashed line represents the creation investment in one equilibrium. Looking at the figure, it is easy to see that creation investments are significantly higher than equilibrium prediction when $A=60$, while appropriation investments are significantly higher than predicted when $A=0$. The allocations are significantly different from equilibrium prediction.

However, we do observe obvious time trends: when $A=0$, investment in outside options $z$ is increasing over time; when $A=60$, investment in appropriation in increasing over time. Regression analysis confirms that there is a significant increasing time trend of $z$ when $A=0$ and a significant increasing time trend of $y$ when $A=60$. Allowing for enough time, we can expect behaviors to converge to the equilibrium allocations.

Table 3 shows the average creation investment, appropriation investment, value created (pie), and payoff for the two treatments, separately by parts. Comparing Part I of the two treatments shows that existing market value significantly increases appropriation investment. However, it does not have a significant effect on creation investment.
Figure 1. Distributions of resource allocations over time in both treatments (left panel: A0_60; right panel: A60_0). Dashed line represents the creation investment in one equilibrium. Creation investments are significantly higher than equilibrium prediction when A=60, while appropriation investments are significantly higher than predicted when A=0.

Table 3 Regression analysis of time trend

<table>
<thead>
<tr>
<th>Variable</th>
<th>A0</th>
<th></th>
<th></th>
<th>A60</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>Round</td>
<td>-0.11**</td>
<td>-0.11***</td>
<td>0.21***</td>
<td>-0.09**</td>
<td>0.11***</td>
<td>-0.02**</td>
</tr>
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<td></td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.06)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Round×Part II</td>
<td>0.04</td>
<td>-0.03</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.02</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.05)</td>
<td>(0.09)</td>
<td>(0.05)</td>
<td>(0.05)</td>
<td>(0.03)</td>
</tr>
<tr>
<td>Constant</td>
<td>5.30***</td>
<td>4.17***</td>
<td>0.54</td>
<td>5.30***</td>
<td>4.12***</td>
<td>0.58***</td>
</tr>
<tr>
<td></td>
<td>(0.24)</td>
<td>(0.20)</td>
<td>(0.34)</td>
<td>(0.21)</td>
<td>(0.22)</td>
<td>(0.11)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,559</td>
<td>1,559</td>
<td>1,559</td>
<td>1,551</td>
<td>1,551</td>
<td>1,551</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.04</td>
<td>0.07</td>
<td>0.12</td>
<td>0.05</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>Number of subjects</td>
<td>104</td>
<td>104</td>
<td>104</td>
<td>104</td>
<td>104</td>
<td>104</td>
</tr>
</tbody>
</table>

Note: Regression with subject fixed effects with robust standard errors clustered at the level of group shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Table 4. Resource allocation and created value

<table>
<thead>
<tr>
<th></th>
<th>Part I</th>
<th></th>
<th></th>
<th>Part II</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$x$</td>
<td>$y$</td>
<td>pie</td>
<td></td>
<td>$x$</td>
<td>$y$</td>
<td>pie</td>
</tr>
<tr>
<td>A0_60</td>
<td>4.68</td>
<td>3.23</td>
<td>27.47</td>
<td></td>
<td>4.90</td>
<td>4.56</td>
<td>31.19</td>
</tr>
<tr>
<td></td>
<td>$\triangleright$</td>
<td>$\wedge$***</td>
<td>$\triangleright$</td>
<td></td>
<td>$\triangleright$</td>
<td>$\triangleright$**</td>
<td>$\triangleright$</td>
</tr>
<tr>
<td>A60_0</td>
<td>4.33</td>
<td>5.31</td>
<td>23.19</td>
<td></td>
<td>4.55</td>
<td>3.14</td>
<td>28.50</td>
</tr>
</tbody>
</table>

*Note:* Statistical significance assessed using Mann-Whitney tests with group averages.

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

**Result 1 (Existing market value):** Existing market value significantly increases appropriation investment.

**Result 2 (Existing market value):** Existing market value does not have significant effect on creation investment.

Analysis shows that neither creation investments nor appropriation investments differ significantly between A0I and A0II or between A60I and A60II (Mann-Whitney tests with group averages, $m=n=23$, $p>0.1$), implying that there are not behavioral spillovers across different market conditions on the aggregate level.

**Result 3 (Previous experience):** Previous experience with a different market condition does not have significant effect on coopetition relationships on the aggregate level.

### 5.2 Conditional strategies

Table 4 shows how players adjust their allocation depending on the difference between two players differences in allocations. Statistical analysis shows that the way players adjust their allocation of resources does not change whether it is Part I or Part II of the experiment. Table 4
therefore pooled the data with the same A value. The dependent variable of these regressions is $v_{i,t+1} - v_{i,t}$, and the two explanatory variables are $|v_{i,t} - v_{j,t}|_+$ and $|v_{i,t} - v_{j,t}|_-$ where

$$
|v_{i,t} - v_{j,t}|_+ = \begin{cases} 
|v_{i,t} - v_{j,t}|, & \text{if } v_{i,t} > v_{j,t} \\
0, & \text{otherwise}
\end{cases}$$

$$
|v_{i,t} - v_{j,t}|_- = \begin{cases} 
|v_{i,t} - v_{j,t}|, & \text{if } v_{i,t} < v_{j,t} \\
0, & \text{otherwise}
\end{cases}
$$

In other words, $|v_{i,t} - v_{j,t}|_+$ measures how players adjust their investments when he invests more than his partner in the previous period, and $|v_{i,t} - v_{j,t}|_-$ measures how players adjust their investments when he invests less than his partner.

Model (1) provides strong evidence of conditional cooperation: a player would increase his creation investment in the current round by 0.32 units for every 1 unit behind his partner in the previous round, but would reduce his investment by 0.52 for every 1 unit ahead of his partner. This conditional behavior does not vary across different market conditions (that is, different values of A).

Model (2), on the other hand, provides evidence of conditional competition: when A=0, players adjust their appropriation investment in a similar fashion as they do with creation investment. However, players are significantly more competitive when A=60: players on average increase appropriation investment by 0.58 units for every 1 unit behind his partner in the previous round, but would reduce his investment by only 0.21 for every 1 unit ahead of his partner. This shows that players are conditional cooperators and conditional competitors, but their conditional behaviors exhibit asymmetry and biased in a self-serving way.\textsuperscript{1}

\textsuperscript{1} Resource allocation and value creation do not differ across treatment in the very first round of the experiment. Therefore, a large part of the treatment effect can be attributed to how players react to each other’s decisions.
Table 5. Conditional strategies

<table>
<thead>
<tr>
<th>(1) Dependent Variable: $v_{i,t+1} - v_{i,t}$</th>
<th>(2) Dependent Variable: $v_{i,t+1} - v_{i,t}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$v = x$</td>
<td>$v = y$</td>
</tr>
<tr>
<td>$</td>
<td>v_{i,t} - v_{j,t}</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
</tr>
<tr>
<td>$</td>
<td>v_{i,t} - v_{j,t}</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
</tr>
<tr>
<td>$A60 \times</td>
<td>v_{i,t} - v_{j,t}</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
</tr>
<tr>
<td>$A60 \times</td>
<td>v_{i,t} - v_{j,t}</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
</tr>
<tr>
<td>Constant</td>
<td>$0.08$</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
</tr>
<tr>
<td>Observations</td>
<td>2,902</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.28</td>
</tr>
<tr>
<td>Number of subjects</td>
<td>104</td>
</tr>
</tbody>
</table>

Note: $|v_{i,t} - v_{j,t}|_+ = \begin{cases} |v_{i,t} - v_{j,t}|, & \text{if } v_{i,t} > v_{j,t} \\ 0, & \text{otherwise} \end{cases}$, while $|v_{i,t} - v_{j,t}|_- = \begin{cases} |v_{i,t} - v_{j,t}|, & \text{if } v_{i,t} < v_{j,t} \\ 0, & \text{otherwise} \end{cases}$. Regression with subject fixed effects with robust standard errors clustered at the level of group shown in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Figure 2. Maximum, median, minimum, and average (±SE) created value on the group level. Some groups successfully maintain highly cooperative relationships achieving the efficient outcome while in other groups no value is created.
5.3 Initial experience on coopetitive relationships

Figure 2 shows information on the value created by the groups across time. As is evident from this figure, there is huge heterogeneity in the created value across groups, with some groups achieving the efficient outcome and others with zero value creation. How can we explain this huge variation in value creation across groups? Because players use conditional strategies, it is likely that initial experience can have a great impact on later interactions. Groups who successfully achieve the efficient outcome by investing all resources to value creation are therefore likely to maintain this mutually beneficial partnerships, while groups who invest a lot in appropriation are unlikely to establish trust and engage in productive value creation in the future.

Table 6 demonstrates the effect of initial experience. The dependent variables are the average created value in the last 10 rounds of each part, while the explanatory variable is the average created value in the first 5 rounds of the experiment. Unsurprisingly, if we focus on Models (1) and (2) in Part I of the experiment, a large proportion of variation in created value can in later rounds can be explained by initial experience in the first 5 rounds. Interestingly, as shown in Model (2) and (4), initial experience still has significant predictive power in Part II of the experiment, after there is a change in market condition.

**Result 4 (initial experience):** Initial experience is important in determine future relationships in the long run, even after the market condition has changed.
Table 6. Regression analysis on the effect of initial experience

<table>
<thead>
<tr>
<th></th>
<th>SYM0_60 (1)</th>
<th>SYM0_60 (2)</th>
<th>SYM60_0 (3)</th>
<th>SYM60_0 (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Part I</td>
<td>Part II</td>
<td>Part I</td>
<td>Part II</td>
</tr>
<tr>
<td>Average value created in the first 5 rounds</td>
<td>0.97***</td>
<td>0.56*</td>
<td>1.29***</td>
<td>1.06**</td>
</tr>
<tr>
<td>Constant</td>
<td>-1.10</td>
<td>14.25</td>
<td>-9.63*</td>
<td>2.43</td>
</tr>
<tr>
<td></td>
<td>(4.48)</td>
<td>(9.73)</td>
<td>(4.68)</td>
<td>(12.38)</td>
</tr>
<tr>
<td>Observations</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.4</td>
<td>0.1</td>
<td>0.61</td>
<td>0.21</td>
</tr>
</tbody>
</table>

Note: Both the dependent variable and the independent variable are the group average across the time span considered. Robust standard errors shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

We propose a model of coopetition where firms need to allocate resources between value creation and value appropriation in strategic partnerships and study the implications of the model both theoretically and experimentally. Consistent with the analysis, when there is competition for existing values, players invest more in value appropriation and less in value creation. Contrary to the equilibrium prediction, subjects in the experiment are significantly more cooperative in a market with existing competition and significantly more competitive in a market with little existing competition. However, we do find behaviors have the tendency to converge to equilibrium prediction, as shown in the literature of social dilemmas.

We find that individuals are conditional cooperators: players adjust their allocation of resources in the direction matching their opponents’ investment level in the previous round. Initial experience has shown to have a significant influence on strategic partnerships: relationships that successfully establish trust at the start are likely to sustain high cooperation level and achieve the efficient
outcome even after the market condition has changed. The experimental data show that, a key to the success of strategic partnerships is to establish trust at the beginning.

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**Appendix Additional figures and analysis**

**Figure A1** Scatter plots of individual allocations. There are some allocations Compared to the equilibrium prediction, (5,5) occurs quite frequently: unsure what are most profitable resource allocation, players may use “equal allocation” as a simple heuristic for decision-making. As seen from the figures, a very small fraction of decisions are consistent with the equilibrium analysis, and there is no evidence that behaviors are converging to equilibrium prediction over time.
Figure A2 Scatter plots of individual allocations. Red crosses represent equilibrium allocations; black triangles represent the average allocations.

Figure A3 Categorization of different strategic partnerships. Groups that keep more than 90% of their resources are categorized as “independent”, groups with average creation investment greater than the median is categorized as “cooperative”, groups with average appropriation investment greater than the median is categorized as “competitive”, while groups who are both cooperative and competitive are categorized as “coopetitive”. We observe the tendency that firms coming from a low competition market to a high competition market makes it more likely to have a “coopetitive” compared to firms in a high competition market without previous experience, while firms coming from a high competition market to a low competition market are more likely to have independent relationships without interaction with each other compared to firms in a low competition market without previous experience.