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REPUTATION FOR COOPERATION: CONTINGENT BENEFITS IN ALLIANCE ACTIVITY

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We model the two-firm alliance as an iterated prisoners' dilemma game with an exit option and test several theoretical predictions in experimental studies regarding the effect of reputation information. Following the literature, we hypothesize that reputation benefits cooperation; however, our experimental results instead show that reputation decreases cooperation. A contingency explains this result while remaining consistent with the general proposition of reputation as beneficial in games of incomplete information. Implications include a recommendation for when to invest in reputation and whether the lemon's market story is applicable to alliance-related inefficiencies.

INTRODUCTION

Our civilization is based upon cooperative interactions among separate parties (Axelrod, 1984). We invest in costly transaction mechanisms (e.g., judicial and legislative systems) to ensure interactions proceed smoothly, because we know that total welfare from cooperative interactions exceeds that from noncooperative interactions in most cases. Free market economies run on the basis and pursuit of cooperative interactions; risks of conflict and misalignments of incentives are costly, and businesses act to mitigate them. When two separate firms choose to conduct a transaction, each expects all parties to bring something of value for exchange rather than to attempt to take something of value. Thus, cooperation is a tenet of interfirm transactions, such as alliances.

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With more than 10,000 partnerships created annually (Schifrin, 2001) and growth rates projected between 25 and 35 percent per annum (Pekar and Allio, 1994; Bleeke and Ernst, 1995; Harbison and Pekar, 1998), alliances are an important transaction governance form in the economy (Das and Teng, 2000). The popularity and growth of alliances, however, does not signify that alliances are any more successful than alternative governance mechanisms like mergers, acquisitions, or internal ventures (de Rond and Hamid, 2004) in appropriating synergies from resources newly accessible to the partner firms. Major consulting firms have estimated failure rates from 50 percent (McKinsey and Company) to 64 percent (PricewaterhouseCoopers) for U.S. ventures, with failure often attributed to opportunistic—that is, noncooperative—behavior by one or both partners (e.g., Parkhe, 1993; Zeng and Chen, 2003). Given the important role of alliances in the economy and the significant likelihood of failure due to a breakdown in cooperation among partners, determining the factors that can increase cooperation in alliances is an important topic in strategy and organizational research.

One factor that has been offered as a means to increase alliance cooperation is reputation (Houston, 2003; Stump and Heide, 1996). Reputation substitutes for costly mechanisms that act to verify the intentions of and monitor the actions of business partners (Hennart, 1991; Kogut, 1988). In fact, sometimes reputation effects are perceived as more important than the threat of legal sanctions in assuring cooperation in alliances (e.g., Wright and Lockett, 2003). Firm reputation is an important resource (Barney, 1991), one that can attract alliance partners (Dollinger, Golden, and Saxton, 1997), as well as contribute to alliance success (Michelet, 1992; Saxton, 1997). A negative reputation can actually hurt cooperation among partners (Polzer, 2004). However, Bolton, Katoka, and Ockenfels (2005) find that although greater reputation information in general leads to greater cooperation, first order reputation information (i.e., where a firm knows its partner's history of cooperation but not its partner's partners' histories) can, under some circumstances, lead to lower cooperation than when no reputation information is available.

Our contribution to the literature is to demonstrate and explain the contingency of reputation-related benefits in an alliance. We show that although more reputation information provides only nondecreasing benefits in theory, in practice the addition of reputation information can decrease alliance benefits. The direction of the reputation effect is contingent upon the payoff structure of the alliance; specifically regarding how the structure affects the benefit of the doubt level of cooperation expected by partners at the beginning of the alliance. From a foundational strategic perspective, we find that the concern of lemon's market (Akerlof, 1970) inefficiencies may be unfounded in specific conditions; in fact, attempting to increase the average level of quality input (here, cooperation) by introducing a market for reputation may actually worsen the result.

We use an experimental method to provide a fuller understanding of the processes and contingencies of the decisions of real players involved in alliance relationships. Because real decision makers are boundedly rational, hold homemade priors about initial cooperation (Camerer and Weigelt, 1988), inhabit worlds of social norms, and so on, the distribution of alliance play differs from the game theoretic expectations (i.e., it reveals greater variance). Thus, instead of only affecting primary incentives *ex ante* (e.g., by making cooperative moves more beneficial and noncooperative moves more costly), reputation effects convey information *ex post* that informs future play because it differs from the theoretical expectation. So, instead of being simply an unused enforcement threat when everyone adjusts correctly to the addition of reputation information to the alliance, reputation (i.e., the historic cooperation level) conveys valuable information about a new partner. When that information shows that a significant proportion of the partner population is not playing as cooperatively as the expected mean of cooperation (the best estimate without reputation information), then cooperation may actually decrease in the game overall. Several strategic implications for managers and policy makers arise from this contingency of benefits of reputation.

The rest of the article is organized as follows. The next section describes the setting and the development of the hypotheses that predict behavior and outcomes in the IPDEO (iterated prisoners' dilemma with exit option) game. Following that, the experimental methods are described, and then the results of the experiments are set forth. This is then followed by a discussion of the results, which includes the development of the contingency explanation, as well as implications and limitations; and, finally, the conclusions are presented.

DEVELOPMENT OF HYPOTHESES

To develop the hypotheses about how reputation affects cooperation in interfirm relationships such as alliances, we need to specify the formal characteristics of the alliance. We choose a model of alliances that has precedent in the literature, both theoretical and experimental. We choose to model the alliance as a specific form of the iterated prisoners' dilemma (IPD) game. This game, both in its pure form and in the form that includes reputation effects, has both theoretical and experimental results to which we can compare the results of our study.

Below, we first summarize the justifications for why the IPD models capture alliance behavior. Second, we summarize the effects that reputation has had on cooperation in these models. Third, we describe the specific IPD model we use here, one

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that is arguably more realistic as it includes an exit option for any partner. Fourth, we develop the predictions for what effects of reputation will be on cooperation-related measures. From these, we form our hypotheses.

The organizational literature describes an alliance as an intermediate form of governance—a method of resource acquisition between the spot market and full ownership (Gulati, 1998; Mitchell and Singh, 1996). Past research has been consistent on the four necessary criteria for defining an alliance accord. First, the arrangement involves two or more firms that combine their resources outside of the spot and corporate control markets in order to accomplish mutual objectives; in our setting, there are two separate firms that are presented the opportunity to make decisions that could benefit both firms. Second, there is repeated interaction with the same partner; in our setting, the iteration of the prisoners' dilemma (PD) game serves as the repeated interaction with the same partner. Third, returns from the alliance depend on the decisions and actions of the partner; in our setting, the PD payoff structure captures the payoff interdependency. Fourth, the arrangement between the firms is voluntary—each firm has the opportunity to terminate the alliance at a future stage; in our setting, the exit option allows such termination (more detail on this option is provided below).

Two-firm alliances are amenable to game theoretic modeling, specifically to the PD metaphor (Dollinger, 1990; Parkhe, 1993; Parkhe, Rosenthal, and Chandran, 1993; Zeng and Chen, 2003). For example, Parkhe (1993) contends, '... alliances are voluntary interfirm cooperative agreements, often characterized by inherent instability arising from uncertainty regarding a partner's future behavior...' (Parkhe, 1993: 794) which creates '... a situation isomorphous to the game of prisoner's dilemma' (Parkhe, 1993: 796). Parkhe *et al.* (1993) conclude from a survey of executives that many actual business alliances exhibit PD-type payoffs. The IPD has become a popular instrument to study the emergence of cooperative behavior in alliances and other interparty relationships.

Although the preponderance of evidence suggests that mutual cooperation tends to emerge when the number of repetitions of the stage game is uncertain (e.g., Ashlock *et al.*, 1996), reputation is expected to increase that level of cooperation. Reputation has been found to positively affect alliance outcomes (Saxton, 1997; Weigelt and Camerer, 1988) and other relationships that have multiple iterations (Granovetter, 1985; Hill, 1990) in survey, theoretical, and experimental research, including when alliances are modeled as IPDs (Andreoni and Miller, 1993; Dollinger *et al.*, 1997). Although there can be substantial (early) cooperation in finitely repeated PDs, as explained in Kreps *et al.* (1982), using reputation-dependent actions, such as ostracism, can increase cooperation levels more (Hirshleifer and Rasmusen, 1989).

For this study, we choose a special form of the IPD game, an IPD that includes an exit option (IPDEO). Players interact repeatedly with the same partner, and both have an option to exit at the beginning of each iteration—at the beginning of each alliance stage, including the first (i.e., they have an opportunity to stay completely out of the alliance). The IPDEO model is formally established in Arend and Seale (2005). Essentially, the model assumes that interdependent relationships, like alliances, are captured in PD-like games (e.g., Axelrod, 1984; Cable and Shane, 1997; Orbell and Dawes, 1993; Parkhe, 1993).[1] However, the IPDEO model adds an important aspect of many interdependent decision situations—that firms often choose to *not play*. Orbell and Dawes capture the importance of the exit option in strategic decisions in their observation that decision makers spend considerable time and effort in 'maneuvering out of bad games with unpromising players and into good games with promising players' (Orbell and Dawes, 1993: 787).

Formally, the IPDEO model entails that the standard (symmetric) PD payoff inequalities hold in each alliance stage that is entered into: $T > R > P > S$ and $2R > T + S$ (Axelrod, 1984). T represents a firm's payoff for unilateral defection, R a firm's payoff from mutual cooperation, P a firm's payoff from mutual defection, and S a firm's payoff from unilateral cooperation. The strategy set includes: cooperate (C), defect (D), and exit (E). When E is played, each firm receives its opportunity cost (o). Each stage of the IPDEO

[1] While we argue that the IPDEO is the most suitable way to model a strategic alliance (i.e., it meets the four conditions, and is symmetrical, competitive in nature, has field support, etc.), it is one of several alternatives that could be considered. Other models, such as based on a coordination game (CG) or a trust game (TG), if iterated, and then provided with an exit option (e.g., becoming an ICGEO or ITGEO), are such alternatives. They would meet the four basic criteria to model a strategic alliance (although the TG is not symmetric, and the CG is not competitive in nature).

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game is represented by the following pattern of payoffs:[2]

		Firm 2		
		C	D	E
Firm 1	C	R, R	S, T	o, o
	D	T, S	P,P	o, o
	E	o, o	o, o	o, o

We assume that the opportunity cost exceeds the payoff for mutual defection but is less than the payoff for mutual cooperation (i.e., $T > R > o > P > S$), as is the standard ordering for PD games with exit options (e.g., Orbell and Dawes, 1993; Tullock, 1985; Vanberg, and Congleton, 1992).[3]

Before we consider how reputation will affect the outcome of the IPDEO, we first summarize what the expected outcome of the model is without reputation effects. Following IPD experimental results when the last iteration is not known, we expect significant levels of cooperation to occur (Axelrod, 1980; Knez and Camerer, 2000; Neyman, 1999; Schuessler, 1989). Players may be able to sustain cooperation in any PD stage because defection would likely trigger exit or defection payoffs that may be unattractive relative to the cooperative payoffs. Arend and Seale (2005) offer a condition to the IPDEO generated through optimization that predicts the minimum requirements for each player to remain in the alliance. The condition represents the level of cooperation (i.e., denoted by p^*—the firm's probability of playing C) that must be maintained for partners to remain in the alliance, as well as the minimum level of belief the player has to have in the partner's playing C in the alliance stage (i.e., denoted by b^*). Higher opportunity costs (o) of each player increase the cooperation and belief levels required.

That condition requires a minimum level of cooperation and belief in partner cooperation of:

$$p^* = \frac{2P - S - T + \sqrt{\begin{array}{c}(S + T - 2P)^2 + 4\\(R + P - T - S)(o - P)\end{array}}}{2(R + P - T - S)} > 0$$

For example, for $T = 10$, $R = 8$, $P = 3$, $S = 0$ and $o = 5$, $p^* = 0.45 = b^*$. We can also consider any one alliance (i.e., set of iterated PDEO stages) that entails an unknown final stage; we can do so by setting a discount parameter (w) to generate an expectation of an alliance lasting several stages (Axelrod, 1984). Consider the payoffs from the three strategies in such a multistage alliance where the final stage is unknown:

$$\text{playing E gives: } \frac{o}{1 - w}$$

$$\text{playing D gives: } Tx + P(1 - x) + \left(\frac{o}{1 - w}\right) w$$

$$\text{playing C gives: } \frac{Rx}{1 - w}$$

where x denotes the probability of the partner playing C, and where we assume that playing D prompts an exit by the partner for the next round, while playing C prompts continued cooperation by the partner. For example, for $T = 10$, $R = 8$, $P = 3$, $S = 0$, $o = 5$, and $w = 0.7$, playing C is optimal for $x > 0.746$ and playing E is optimal for $x < 0.286$ (defecting is optimal for intermediate x levels). In either case, we can estimate a level of belief in partner cooperation necessary for cooperation to be a rational choice.

Having reputation information about a partner should affect the belief level and, therefore, the level of cooperation. Specifically, having accurate information about the partner's past level of cooperation in IPDEO games with other partners should affect the firm's level of belief in the partner's cooperation in this IPDEO and, hence, the strategies it plays. For instance, if the partner has a cooperation level below 0.40 in IPDEO games characterized by the example payoffs above, we would expect the firm to exit initially (i.e., choose to not play with that partner); if the level is above 0.75, we would expect the firm to cooperate initially.

Not only do we expect reputation information to affect how a firm plays any given partner, but

[2] The compressed normal form of the game (the 3×3 matrix above) is a convenient representation of the two-stage game that is used in the experiment. The first stage involves the choice of exiting or playing the PD; the second stage involves the PD game contingent on both partners having chosen not to exit.

[3] $R > o$ ensures that firms do not exit when each rationally expects to benefit if both parties cooperate; $o > P$ makes the alliance stage nontrivial; it makes the partners have some risk to their relative wealth when the alliance is entered.

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we also expect a firm to adjust its own strategies knowing that its reputation information will be used by its future partners. Building a reputation for cooperation early should help the firm garner more cooperation from future partners, and since $R > o > P$, we would expect firms to find such an investment worthwhile (i.e., worth giving up the short-term gain of $T - R$). We can show this intuition formally. Let m denote the number of future alliances (with new partners), and let y denote the expected partner cooperation level given that the firm's reputation for cooperation is above the critical level required for a partner to rationally cooperate (as computed by any method, including those two shown above). We assume that the firm is hovering at the critical level now, that the incremental benefit to further cooperation is obtaining R rather than o for future alliances, and that the incremental loss is obtaining R rather than T in the current stage:

$$\text{incremental benefits} - \text{incremental losses}$$
$$\Rightarrow \left[mw\left(\frac{Ry - o}{1 - w}\right)\right] - [(T - R)y + P(1 - y)]$$

For example, for $T = 10$, $R = 8$, $P = 3$, $S = 0$, $o = 5$, $w = 0.7$, and y near 0.75, m needs only to be 1 for the benefits of cooperation to exceed its costs. In the example, we are implicitly assuming all firms rationally do the same calculation so that future alliances will end up as cooperative relationships (i.e., rather than the firm having to exit because the partner has irrationally let its reputation fall below the critical level). Even if that is not the case, and the expected incremental benefits fall, as long as there are mostly rational partners in the population, then having the reputation information available will provide incentives for more cooperation than when no reputation information is available in cases where the discount parameter and number of future alliances are high.

We have shown a rationale, both intuitive and mathematical, that reputation information should increase cooperative play. We also argue that reputation information should not reduce cooperative play. The incremental benefits for a reputation of cooperation are positive as long as we do not expect that partners are more likely to defect on a firm that has acted cooperatively in the past than one that has not. Given the instantaneous incremental benefit to such a partner is $T - R$ but it loses out on potentially numerous rounds of R rather than o, and it hurts its own reputation in doing so, we do not expect that such a myopic response to be the rule. We expect that the addition of reputation information to be generally beneficial to cooperation, and specifically non-detrimental (as others have predicted about reputation information in general—Ely and Välimäki, 2003).

With the prediction that reputation information should increase cooperation in the IPDEO, it is relatively straightforward to offer several related predictions. If firms are cooperating more, then because $R > o$, there should be fewer exits from the alliances when reputation information is available. If there is more cooperation and longer alliances, because $R > o$, and $2R > T + S$ (by definition), then there should be greater overall welfare with reputation information. If there is more cooperation, then all firms should hold greater beliefs of partner cooperation (e.g., due to Bayesian updating) when reputation information is available.

The hypotheses follow:

Hypothesis 1: Relative to having no reputation information, alliances where reputation information about past partner cooperation is available will exhibit greater average cooperation.

Hypothesis 2: Relative to having no reputation information, alliances where reputation information about past partner cooperation is available will exhibit greater average alliance length (i.e., more stages completed before a partner exits).

Hypothesis 3: Relative to having no reputation information, alliances where reputation information about past partner cooperation is available will exhibit greater average payoffs.

Hypothesis 4: Relative to having no reputation information, alliances where reputation information about past partner cooperation is available will exhibit greater average beliefs about a partner's future cooperation.

We have generated four hypotheses that are testable in a unique and most appropriate setting—the IPDEO. This is a setting that represents an important business interfirm relationship—an

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alliance. This is a setting where there are established theoretical and experimental results to compare with (i.e., the PD and IPD literatures). This is a setting where the currency that generates reputation is the same currency that rewards reputation (i.e., that currency being in the form of payoffs from the game).

This is an incomplete information setting that allows testing of two important effects of reputation: (1) how reputation affects the play within an alliance (e.g., does a good reputation increase the likelihood of partner cooperation?); and, (2) how reputation affects whether any play of the alliance occurs at all (e.g., does a bad reputation increase the likelihood that no partner will ally with the firm?). The former effect makes explicit the level of reputation expected to signal that a partner will cooperate and continue to do so in the repeated game (Fudenberg and Maskin, 1986). The latter effect makes explicit the cutoff partner reputation level for certain firm types to enter the market of alliances, revealing whether a lemon's market (Akerlof, 1970) inefficiency is present or not (i.e., whether the most cooperative players choose to stay out of alliances).

Reputation information challenges players with extra levels of reasoning to consider. At the most basic level, players make use of information about a partner's past play to decide whether and how to conduct an alliance with that partner. At a slightly higher level, each player has a *theory of other minds* (Morris, Ames, and Knowles, 1993), here, of the mind of the partner, in that the player believes that the partner will similarly use the player's past decisions (i.e., reputation information) in choosing strategies in any alliance with the player. Here, the player essentially considers how to shape its image for consumption by partners. (By shape, we mean that we expect it to be possible to fool future partners about a player's true future nature—i.e., a player may be able to 'shark' by playing cooperatively to set up a compete-and-defect move.) This is the level of reasoning used to hypothesize why payoffs will change when reputation is introduced. At higher levels of reasoning (e.g., where a player considers how its current actions could affect the perception of its current partner's response by that partner's future partners), many more assumptions are required about signals sent, about how they are received, and about players' abilities to track and update beliefs. We did not formally account for these higher levels of reasoning when generating the hypotheses.

Our reasoning to this point is not based on game theoretic equilibrium calculation (i.e., with the accounting of all the Bayesian updating of all the potential levels of reasoning and signaling that could occur); it is based on simple calculations of conditions, at the lower levels of reasoning (i.e., a player uses the partner's reputation, and believes the partner uses the player's reputation, to make decisions about the alliance strategies chosen). We take this simpler analysis for two main reasons. First, it is consistent with the analysis of the base game done in preceding published work. Second, we are interested in how real players will use reputation information, and expect that the lower levels of reasoning are the most appropriate set to consider for non-superrational decision makers.

EXPERIMENTAL METHOD

The study was designed to measure the effects of reputation information on levels of cooperation, alliance length, overall benefits, and beliefs of partner cooperation likelihood.

Subjects

Seventy-two subjects, predominantly undergraduate business students enrolled in two senior-level strategy courses, participated in the experiment. Members of each class were randomly assigned to one of two experimental conditions described below. Subjects were motivated to make thoughtful decisions by basing part of their course grade and extra credit on how many points they earned during the experiment. Most students were between the ages of 21 and 35, with an approximate balance between males and females.

Procedure

We conducted the experiment at a computer lab at a major university that contained over 20 networked computer stations. Subjects were randomly assigned to a workstation that was preset to play one of two experimental conditions. Instructions that the students had been exposed to in class (see Appendix for copy of instructions) were available for reference at each station. The participants were requested not to communicate with each other.

The instructions indicated that they would play a set of simple two-person games over a computer network. The game, which was designed with PD-type payoffs and included an exit option, was introduced as an *Alliance Formation* exercise. The instructions also indicated that during the course of the experiment, subjects would be randomly paired with several different players for a number of repeated trials (stage games) with an unknown number of set trials. When the students were exposed to the instructions and game in class prior to the experiment, it was shown that no pure strategy (e.g., always playing C) was optimal; it was shown that better strategies would take into account what the player believed the partner would play.

At the beginning of each trial, subjects were required to make one of three decisions: *cooperate, compete*, or *opt out*. Their earnings for a *cooperate* or *compete* decision depended on the decision of the person they were paired with. As indicated below, the payoff for mutual cooperation is 8, for mutual defection 3, for unilateral defection 10, for unilateral cooperation 0, and for opting out 5. The exit payoff is analogous to opportunity cost in an alliance model—it represents the next best alternative to not joining or not continuing the alliance partnership. The instructions contained the following payoff table to aid subject decision making.

Your decision	Your partner's decision	
	Cooperate	Compete
Cooperate	8, 8	0, 10
Compete	10, 0	3, 3
Opt out	5, 5	

At the beginning of each trial, prior to making their strategy decision, the computer requested that subjects estimate their belief in their partner cooperating in that trial. At the end of each trial the computer informed subjects of their partner's decision, and reported both the cumulative and current earnings for the trial. At the end of the seventh pairing, the computer informed subjects that the experiment had ended and provided a recap of their cumulative earnings. Subjects then completed a short exit survey. Debriefing was completed after all four experiments were concluded.

The study consisted of two experiments of 18 subjects where no reputation information was provided, and two experiments of 18 subjects where reputation information was provided. The reputation information consisted of four items, available on screen: the partner's cooperation history (i.e., the number of times the partner cooperated in alliances prior to these alliances ending); the partner's defection history (i.e., the number of times the partner competed in alliances prior to these alliances ending); the partner's exit history (i.e., the number of times the partner opted out in alliances); and, the historic alliance stage completion ratio (i.e., the number of alliance stages the partner was able to play in the past relative to the maximum number of stages the partner could have played). Subjects were uncertain as to how long the alliance pairings would last. Consistent with the way unknown game lengths are handled in other studies (e.g., Axelrod, 1984), we told the subjects that there was a significant positive probability of switching alliance partners on the next trial. Players were informed each time their pairing changed, and were randomly paired with seven different players during the course of the experiment, which lasted for 60 trials.

RESULTS

The results from the study are not supportive of the hypotheses; in fact, they indicate statistically significant support for the *opposite* effects. Two-tailed t-tests of differences in means (of the experiments with reputation information versus the experiments without reputation information), assuming different variances, provided the following results.

The overall cooperation level (i.e., the proportion of cooperative play in all stages of alliances played pre-exit) decreased 10 percent ($p = 0.02$) with reputation information. The choice of cooperation in the initial stage of any alliance decreased by 12 percent ($p = 0.005$) with reputation information (i.e., from 79% to 67%). Thus, Hypothesis 1 is refuted; the opposite of Hypothesis 1 is supported.

The average alliance length (i.e., the proportion of alliance stages played pre-exit relative to the possible alliance stages) decreased by eight percent ($p = 0.075$) with reputation information (i.e., from 63% to 55%). Thus, there is some evidence to

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refute Hypothesis 2 and support the opposite of Hypothesis 2.

The overall welfare, as measured by the average alliance stage payoff of players, decreased by 0.34 francs ($p < 0.0001$) with reputation information (i.e., from 5.77 to 5.43). Thus, Hypothesis 3 is refuted; the opposite of Hypothesis 3 is supported.

The beliefs of partner cooperation, as measured prior to every played alliance stage, decreased by six percent ($p < 0.0001$) with reputation information (i.e., from 62% to 56%). Thus, Hypothesis 4 is refuted; the opposite of Hypothesis 4 is supported.

Subjects' responses to the exit survey (not part of the formal hypotheses tests) revealed some valuable insights regarding reasoning. Responses, measured on a five-point Likert scale (where 1 = not at all, 5 = a lot), were significantly different from one regarding answers to whether the players were looking ahead when choosing strategies (e.g., considering the reaction of the partner to a current choice), possibly in order to shape their reputations. Additionally, the pre-choice per-trial question that had each player estimate the partner's probability of cooperating, showed significant correlation to a current choice (e.g., if the player chose to compete, the belief that the partner would then cooperate decline significantly). These results, complemented by the main results, show that players used at least the basic levels of reasoning regarding how reputation affected play both within a current alliance, and in possible future alliances.

DISCUSSION

These results that support the opposite of the hypotheses represent an opportunity for us to determine what mechanics and contingencies were at work in what was considered a relatively well understood and simple modification to a game. While the result that reputation data, of the first order historic play variety, can reduce cooperation has been observed before (e.g., Bolton *et al.*, 2005, recorded a 12% decrease in cooperation in an image scoring game when reputation information was introduced), we consider the explanation for the results in this setting new to the literature. When we analyze the distribution of cooperation levels in the experiments, we can begin to appreciate what drives the surprising results.

What we observed in the experiments were widely distributed cooperation levels that were roughly normally shaped and spanned the full range of cooperation levels (from 0% to 100%).[4] Players chose different strategies than predicted, and so the reputation data became of greater value because it was new and accurate information that could be a better basis of decisions (i.e., a better basis than what players could have predicted about partner play without such reputation information).

What we see in the IPDEO game is a difference in play arising because the reputation data informs players when a critical level of reputation that would elicit cooperation is not met by a potential partner *in a situation where the expected mean level of cooperation lies above that critical level* (see Figure 1, upper panel). Essentially, with the right payoff structure, players expect that the average cooperation level of partners lies above the critical level that induces cooperation. Essentially, when no reputation information on specific partners is available, every potential partner is given the benefit of the doubt level of expected cooperation (e.g., the mean level of the population), at least initially. One can see that the initial cooperation level for the experiments with no reputation information was 79 percent, a high enough level given the payoff structure to rationally elicit cooperation under the example critical levels calculated in the second section of this article. Thus, without reputation information, under certain conditions, cooperation can be induced because the players use the mean level they expect as the best basis to decide whether to cooperate or not in the initial stage of a new alliance, and when that mean level lies above the critical level, they do cooperate initially. However, when reputation data is available, the players can then discriminate among partners, and no longer have to rely on the mean level; they can use the actual level of cooperation of the partner to inform the decision of whether to cooperate or not. In this case, because there was a substantial set of players with poor reputations (i.e., with low levels of past cooperation), we observed many players initially not cooperating with these partners that were unlikely to cooperate.[5]

Figure 1's upper panel shows the case where a substantial proportion of the population holds reputations for cooperation that lie below the critical

[4] Although the range of cooperation levels observed was wide, those who cooperated more significantly outscored those who defected more.

[5] Better reputations increased both cooperation and game length with partners.

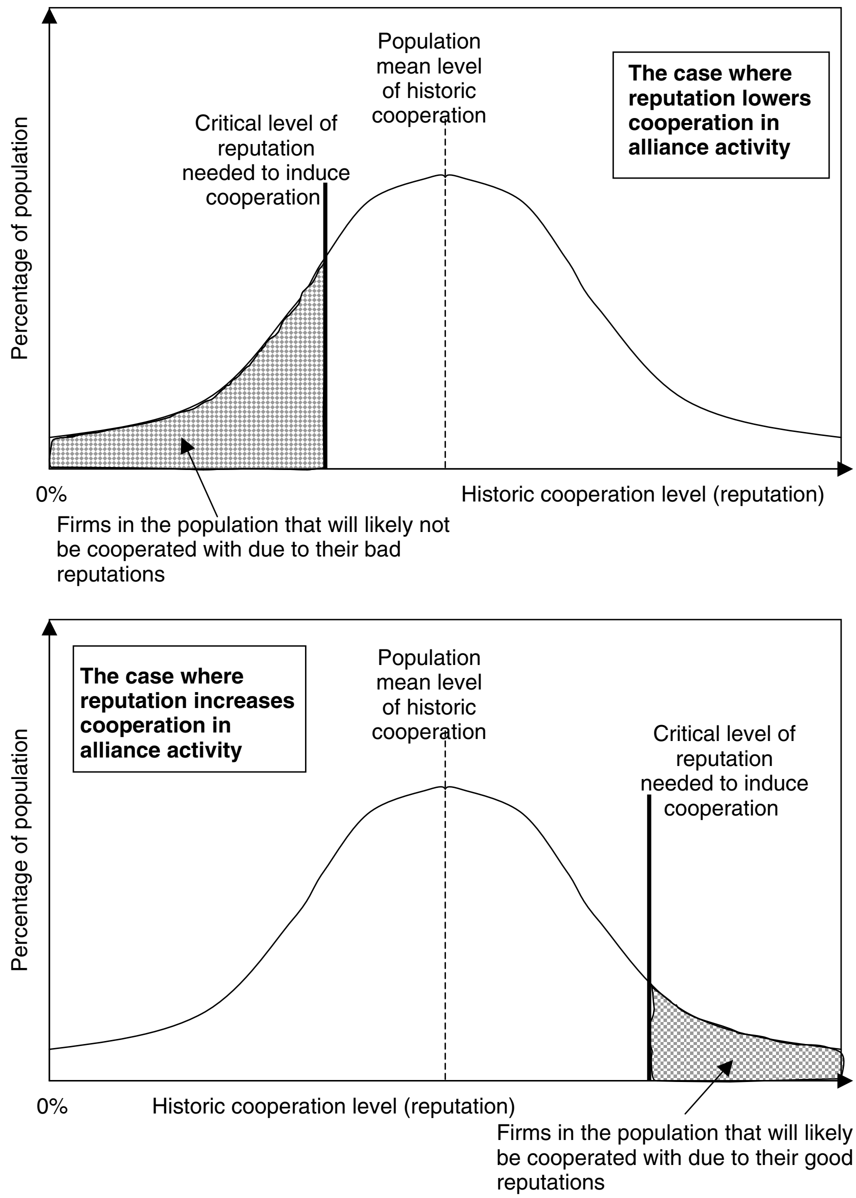

Figure 1. The contingency of the mean reputation level on how reputation affects cooperation in alliance activity

level when the mean of the population distribution lies above the critical level. In that case, which apparently was the case for the IPDEO payoffs chosen here, we observed greater cooperation in the no reputation case than in the reputation case. Reputation actually rationally decreased cooperation because it provided information about bad partners who would otherwise have obtained cooperation (being bunched with the rest of the population when no reputation data was available) and may have been more willing to reciprocate as a result.[6] Analysis of the stage cooperation levels is consistent with this explanation. In every alliance after the first (where no reputation information was available), the initial cooperation level

[6] We tested to determine whether reputation predicted a higher likelihood of a player choosing the compete strategy (i.e., defecting), comparing the reputation experiments to the experiments with no reputation data. When the players could hide their bad histories, and they had histories of noncooperation, they were not significantly more likely to compete. In other words, when they could hide their histories, they actually cooperated more.

of the alliances where reputation data was available was significantly lower. That initial cooperation level difference then affected the subsequent cooperation, the length of the alliance, the average payoffs, and the beliefs about partner cooperation.

A subsequent study where we altered the exit payoff to reduce the expectation of cooperation also provided evidence to support the explanation. Altering o from five to seven francs moved the mean of expected cooperation to a level below the critical level (see Figure 1's lower panel). However, the population distribution contained players with very high levels of past cooperation; high enough to induce partner cooperation when reputation data was provided. In that case, overall cooperation was significantly increased when reputation information was available, up 16 percent ($p = 0.003$).

Thus, our explanation for the results is one about contingency: when the mean expected level of cooperation lies above (below) the critical level for cooperation and the distribution of reputation is wide,[7] reputation information will decrease (increase) cooperation.[8]

The hypotheses, of course, were based on the expectedly rational play of the IPDEO game (both from past theoretical analysis and from experimental evidence), whereas the results emerged from a realization that the reputation effects were more complicated, contingent on the game's payoff structure. From a theoretical perspective, we expected the cooperation level of rational players to be at least at a high enough level to induce partner cooperation (i.e., we expected all players to cooperate at a similar level that induced cooperation and continued alliance play, given that mutual cooperation is preferred to the exit payoff, if they had not decided to exit). And, with reputation information, we expected that level to be even higher (i.e., whether the player wishes to elicit continued cooperation in a long alliance or to hit-and-run with an initial defection-and-exit strategy, the player obtains higher payoffs when its reputation induces cooperation from the partner).

What we observed was a second role for reputation information—that is, reputation information providing real-time information to decision makers as the game is played; this is above its theoretical first role of affecting *ex ante* the incentives of players when the game is presented. Theory based on that first role predicts that reputation affects the payoffs of the game and that players will adjust strategies to those new incentives, and the game outcomes should then be predictable (i.e., assuming no trembles). That first role works through the threat that bad reputations could be punished by the subsequent (retaliatory) choices of partners; this is usually a role that is fulfilled without ever having to enforce that threat, because rational players are expected to stay on the predicted path. In reality, though, players displayed a range of paths and the second role of reputation information was revealed.

This explanation offers several significant implications. For managers contemplating interfirm partnerships, investment in the creation and monitoring of reputation information should be higher when the mean likelihood of general partner cooperation is lower than the critical level needed to induce cooperation by the firm. Reputation building and monitoring is more valuable in those circumstances. A firm may have strategic advantage when it is better at researching the critical reputation level and mean population reputation level in order to know when it is best to invest in reputation, and when it can better coordinate alliances.

For a public policy maker, on the one hand, it may be sensible to actually deter reputation investments when the mean level of expected cooperation is higher than the critical level for specific types of interparty relationships, especially of boundedly rational decision makers who are trying to reduce costs (e.g., entrepreneurs).[9] On the other hand, welfare may be improved by subsidizing reputation information flow to generate more cooperative alliances when the mean level of cooperation is likely to lie below the critical level.

[7] Note that this study does not focus on *why* the distribution is wide; it takes such data as observed fact. There are several possible explanations for the wide range though (which is for future work to consider) that would include the mixed-strategy optimization problem when decisions are made in a discrete sequence (i.e., it is difficult to get the right fraction of cooperation signaled when the partner observes a sequence of Cs and Ds).

[8] Note that the contingency explanation is robust to different calculations of payoffs. For example, if utility functions are used instead of payoff currency to compute optimizations (e.g., with risk-averse players taking into account the variance of cooperative play as well as the mean), the main argument holds—the critical level will simply be higher.

[9] Such methods of deterrence might include: legislation and enforcement to reduce signals (akin to libel and slander cases); the active creation of noise (misinformation) about firms and alliances in the industry media; and so on.

A significant theoretical implication[10] relates to the lemon's market story (Akerlof, 1970), because our explanation appears to contradict the problem and solution of that market. In a market that contains a distribution of types (e.g., of quality), the problem of the best types choosing not to participate and having the mean (quality) of participating types fall (i.e., the lemon's market problem) is solved by the provision of information about the type (e.g., reputation of quality) because then the better types receive a fair price rather than the mean price. In our explanation, we assert that under certain circumstances the mean (cooperation) will actually fall when the provision of information about type (i.e., reputation for cooperation) occurs. Differences in these games drive the differences in the results. In the market, a fine instrument (i.e., price) is available to reward better types; in the IPDEO, only a blunt instrument (i.e., whether to cooperate or not) is available. In the market, better types have greater opportunity costs; in this IPDEO, they do not. Payoffs in the market come from exogenous buyers; payoffs come from other players (unless the firm exits) in the IPDEO. So, under the conditions of an IPDEO, the lemon's market analogy may not be applicable. There may be circumstances where more information about quality (e.g., reputation information) may lower the mean level of quality. An analysis of the experiments supports that conclusion. Higher quality players (i.e., those with better reputations for cooperation) had higher levels of alliance participation (longer alliances) than lower quality players in both experiments; thus, not having type information did not deter high-quality types from participating in the market, they actually participated more.

Several shortcomings and limitations of this study are noted. First, the IPDEO model may not apply to all interfirm business relationships like alliances (i.e., the results are more likely to apply to those relationships that involve multiple stages of commitment where the payoffs to the partners in each stage are commonly known and resemble a PD). Second, several aspects of the experimental design may be questioned, including: no control for gender effects and other possibly relevant subject characteristics; a focus on only one payoff matrix; and, the usual limitations that are involved in paying subjects using grades and extra credit. However, we have no evidence to suspect that gender, other relevant demographic characteristics, or paying subjects in an alternative manner would change the main results.

We note that this study is also limited in its ability to monitor and control the full set of possible levels of reasoning by players and their related rationales for shaping their reputations (in those treatments where such information was available). We have evidence, both from the exit survey and the in-game belief estimates, that players used at least the basic levels of reasoning regarding reputation (i.e., partner reputation influenced player strategies, and players expected their current choices to affect subsequent responses by partners). We did not question directly about second and higher levels of reasoning and shaping behavior. We found no evidence of second-level reasoning effects, however, in testing for them in conditions most likely to create them *ex post*. Regardless, there is no evidence that higher levels of reasoning shaped the main results, including the contingency effect.

The contingency effect is based on how player beliefs are affected by information (i.e., reputation) in light of how those beliefs are altered by payoff structure. The focus on player beliefs as driving outcomes is consistent with the epistemic program of game analysis. In arguing the hypotheses, and in explaining the results, the analysis has been based on calculating conditions for certain expected strategies, outcomes, and responses to treatments, rather than being based on traditional game theory equilibrium analysis. Thus, it is possible to analyze a game-based model without a traditional analytic lens, yet remain strong in the logic, mathematics, and reasoning behind hypotheses and explanations of results.

On a bigger picture scale regarding the interpretation of the main result—that is, that the benefits of reputation in an alliance are contingent—we can argue that our insights are not limited to the specific base game (i.e., prisoners' dilemma) chosen here. Appropriately modified base games, such as the coordination game (CG) and the trust game (TG) (i.e., becoming ICGEO and ITGEO games), when used to model alliances that are composed of repeated stages and where partners in the games

[10] There is also a research implication for experimental work. Researchers should try to determine the implicit assumptions of their subjects, such as homemade priors (Camerer and Weigelt, 1988) and other beliefs that subjects retain despite instructions provided, because those assumptions may contingently influence results.

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can have future alliances, and where reputation information could follow them, are also potential applications of our contingency effect. If reputation is information about how players chose strategies in past plays of a TG or CG, and if bad reputation is unattractive to potential partners (e.g., they split the pie less fairly in the TG, or choose lower potential payoff options in the CG), then we do see our results in the IPDEO as applicable to these alternative formulations of alliance activity. When there is a game (payoff matrix) where there is a high benefit of the doubt level for good play while the population includes a significant proportion of 'bad apples,' then the addition of reputation information should make outcomes worse in the ITGEO and ICGEO games that model strategic alliances as well. It remains for future work to verify the applicability of the IPDEO results in alternative models.

CONCLUSIONS

The primary purpose of this study was to examine how the addition of reputation information to interfirm relationships affected cooperation. Using the IPDEO model proposed by Arend and Seale (2005), we developed then tested hypotheses concerning alliance behavior when players could build reputations and monitor partner reputations in a series of multiple-stage alliance opportunities with different partners. The main results of our experiments provided support for the opposite effect of reputation on cooperation than predicted; the results showed that reputation actually decreased cooperation, alliance length, and overall partner welfare. We found an explanation for these unusual results in a contingency story. When the mean expected level of cooperation lies above (below) the critical level for cooperation and the distribution of reputation is wide, reputation information will decrease (increase) cooperation. Thus, the importance of investment in reputation (e.g., in reputation building and monitoring) is greatest when the mean expected level of cooperation lies below the critical level for cooperation. Additionally, we find that the lemon's market argument for reputation information in alliance settings is not necessarily applicable; more information about participating types may actually reduce mean quality. We hope that this research can spur further work into the exposure of contingencies that are waiting to be discovered through experimental settings. Real players decide with a rationality that is often difficult to predict *ex ante*, yet can entail important contingencies that are *ex post* understandable and applicable to other important and strategic settings.

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APPENDIX

University of XXX

Department of YYY

Alliance Formation Experiment

Please read and understand this handout prior to doing the simulation.

Please come to the lab ready to complete the experiment on the day assigned.

Welcome to the experiment on alliance formation. The instructions are simple. If you follow them carefully and make good decisions, you will earn a considerable amount of extra credit points. The number of points you earn will depend on your relative performance in this experiment. The amount of the bonus will also depend on the number of points you earn. How you earn points will be explained below. If you have any questions before or during the experiment, please raise your hand.

Background

Businesses often form alliances when there are opportunities to share costs, share risks, or gain synergies by working together. Some alliances are short-lived, lasting no longer than a single project, while other alliances may span multiple projects and last as long as both parties are willing to continue the commitment. Typically, an alliance ends when the project is completed, or when one or both partners decide to opt-out. During the course of an alliance, the alliance partners may have multiple chances to either cooperate or compete with one another. While cooperation may result in higher earnings for the alliance as a whole, each individual partner may find that it could earn more by competing. The decision the partners often face is one where they (1) earn a fair return by cooperating, (2) earn considerably more by competing, but may risk losing their alliance partner, or (3) may opt out of the alliance altogether and earn, on average, the return of their next best alternative. This is the kind of decision we are trying to model in this experiment.

Description of the task

Look around the computer lab. You are one of many people participating in today's experiment. At the beginning of the experiment the computer will randomly pair you with another person. This pairing, which is explained in greater detail below, will last for a number of rounds (trials). At the beginning of each trial, the computer will display a payoff table, similar to the one below, and ask you to make one of three decisions—*cooperate, compete,* or *opt-out*. Your payoff will be determined by the decisions that both you and your partner make.

After you have made your decision you will see a screen asking you to *please be patient*. You are waiting for other people to complete their decisions. After everyone has made a decision, the computer will display the results for the trial—you will see the choices that you and your alliance partner made, your earnings for the trial, and your cumulative earnings across all trials. For example (see table below), if both you and your alliance partner choose to cooperate for the trial, each will earn eight francs (francs are an experimental currency that may be converted to extra credit points at the end of the experiment). If you choose to cooperate and your alliance partner chooses to compete, you will earn nothing, while your alliance partner will earn 10 francs. If you choose to compete and your alliance partner chooses to cooperate, you will earn 10 francs, while your alliance partner will earn nothing for the trial. If both of you choose to compete, each will earn three francs. As you examine the payoff table below, note that the columns represent your alliance partner's decision, and the rows represent your decision. *The first number in each cell of the table is your payoff and the second number is your partner's payoff.*

Your decision	Your Alliance Partner's Decision	
	Cooperate	Compete
Cooperate	8, 8	0, 10
Compete	10, 0	3, 3
Opt-out	5, 5	

On any trial you may also choose to opt-out. If either you or your alliance partner chooses to opt-out, each of you will earn five francs for the remainder of trials for which you are paired.

Reputation/outcomes

The number of cooperate, compete, and opt-decisions that each player has made are tracked by a central computer. Each time you are paired with a new player, several measures summarizing that player's reputation or past outcomes are reported on your decision screen. At the top of this screen you will see a table, similar to the one listed below. In this example, imagine that you have completed 22 trials and are once again paired with a new player. The following items are reported:

Reputation/outcomes of player you are paired with	
Percentage of scheduled trials completed:	50
Number of *cooperate* decisions:	8
Number of *compete* decisions:	3
Number of *opt-out* decisions:	2

In the example above, the player you were just paired with cooperated on eight previous trials, competed on three trials, and opted out of two pairings. Although you do not know when or why this player opted out, you can tell that he/she completed 50 percent of the scheduled trials [(eight cooperate + three compete)/22 completed trials]. Note that the player you are paired with is given similar information on your previous decisions. The number of *cooperate, compete,* and *opt-out* decisions, as well as the *percentage of scheduled trials completed,* is updated at the start of each trial.

Estimating your partner's decision

After reviewing the reputation/outcome information, you are asked to estimate the probability that the player you are paired with will cooperate on the next trial. You make this estimate, from zero to 100 percent, by moving the slider button with the computer mouse. Note that the computer requires you to make an estimate before allowing you to make your decision to cooperate, compete, or opt-out.

The experiment will last *at least 50 trials* and you will likely be paired with several different alliance partners during the course of the experiment. The *length of each pairing is determined randomly*, and you will not know in advance how long each pairing may last. Essentially, you will have a 75 percent chance of continuing with the same partner in the next round. However, the computer will inform you each time you are paired with a new alliance partner.

If you have any questions, please raise your hand. We sincerely thank you for your participation.

Good Luck!