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and Supply Chain Performance:
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Supply chain contracting literature traditionally has focused on aligning incentives for economically rational players. Recent work has hypothesized that social preferences, separate from economic incentives, may influence behavior in supply chain transactions. Social preferences refer to intrinsic concerns for the other party's welfare in the case of a positive relationship and intrinsic desires for a higher relative payoff compared with the other party's when status is salient. This article provides experimental evidence that social preferences systematically affect economic decision making in supply chain transactions. Specifically, supply chain parties deviate from the predictions provided by self-interested profit-maximization models, such that relationship preference promotes cooperation, individual performance, and high system efficiency, sustainable over time, whereas status preference induces tough actions and reduces both system efficiency and individual performance.

Key words: social preference; relationship; status; supply chain performance; experimental economics

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1. Introduction

Traditional economics assumes that people are self-interested, rational agents. In a decentralized decision-making system, such as a transaction between a supplier and a retailer, the decisions of self-interested agents normally are suboptimal for the overall system, because the actors' interests are not perfectly aligned. In supply chain contracting literature, coordinating contracts have been designed to achieve full system efficiency by enforcing the optimal contract for the system through economic incentives (for an overview, see Cachon 2003).

Most supply chain contracting models are based on the assumption of self-interested, rational agents and exclude social considerations, such as reciprocity, status seeking, or group identity. However, recent developments in behavioral economics suggest that actors may care about reciprocity, fairness, and status in addition to economic benefits (Camerer 1999, Charness and Rabin 2002; Fehr and Gächter 2000; Rabin 1993). Furthermore, research in sociology and psychology implies that people have emotionally based social goals that cause those involved in social interactions to pursue reciprocity, status, and group identity as "ends in themselves" (Fiske 2002; Kendrick et al. 2002; Loch et al. 2006). Consistent with this work, recent models of social preferences in supply chains have suggested that social preferences may mitigate double marginalization and help to achieve channel coordination (Cui et al. 2004; Wu and Loch 2006).

The current study experimentally investigates how social preferences influence supply chain transactions. We design a sequential mover game in which two players make decisions about profit margins that jointly determine consumer demand. This design represents the supply chain structure of a supplier and retailer with a simple wholesale price contract.

With this game, we examine the effect of social preferences in two studies. The first study presents participants (who play as either the supplier or the retailer) with scenarios in a short questionnaire and tests for the influence of social preferences in a "one-shot" transaction. The second study includes two players (a first mover, or supplier, and a second mover, or retailer) who repeatedly interact via computer. In the control condition of Study 2, two randomly matched participants play the game without seeing each other or having any other social interaction; in the relationship condition, the two participants may introduce themselves to each other and are cued to assume a good relationship before the game; and in the status-seeking condition, players are told that in each round, the one who gains more than the other side is ranked the "winner." Payoffs remain unchanged across conditions and do not depend on the winner status, nor is the participants' future affected by whether they know each other.

The experiments indicate that participants systematically deviate from profit-maximizing behavior in all conditions. While a positive relationship promotes and maintains mutually beneficial actions

from both sides, status seeking induces more competitive behavior by both players and drives down individual performance and overall efficiency. The results persist over many repeated rounds of the game, indicating that the social preferences shift equilibrium behavior.

The remainder of this article is organized as follows: In the next section, we review related literature in behavioral economics, sociology, and supply chain contracting. In Section 3, we report on the one-shot Study 1. We present the experiment design and predictions of Study 2 in Section 4 and report the results in Section 5. Section 6 summarizes our results.

2. Related Literature

Supply chain contracting has been studied in operations management because a simple linear price contract is not efficient in a decentralized supply chain system. Self-interested profit-maximizing agents in a supply chain dyad with linear pricing suffer an efficiency loss, known as double marginalization (Spengler 1950). To achieve full channel efficiency, various forms of coordinating contracts have been designed (Cachon 2003).

Recent experimental studies of contracting show significant deviations from the behavior predicted by contracting theories. Most of this work has focused on the effect of individual decision biases, such as loss aversion. Ho and Zhang (2004) find that channel coordination fails with various (wholesale price, two-part tariff, quantity discount) contracts. Similarly, Lim (2004) observes that channel efficiency is lower than theoretical predictions. In a supplier–newsvendor setting (one party is a human subject, and the other party is a computer programmed to act as a profit maximizer), Katok and Wu (2006) find that buy-back and revenue-sharing contracts do not provide full channel efficiency. Keser and Paleologo (2004) also find that, in a supplier–newsvendor structure, profits migrate from the supplier to the retailer compared with the theoretical prediction. Several authors have explained these experimental findings with behavioral decision models, such as loss aversion and counterfactual thinking (Ho and Zhang 2005; Lim 2004).

Whereas these models focus on individual decision biases, namely, loss aversion, the experiments in our study investigate the effect of social considerations on the basis of previous research in psychology and sociology, which has identified emotionally based social goals that are pursued as ends unto themselves. These goals include relationship concerns, status seeking, and a desire for group identity (in addition to self-protection, mate choice, and offspring care, which are less relevant in supply chain interactions; see Kendrick et al. 2002). First, relationships among people are sustainable because humans value reciprocity and feel an intrinsic need to punish failures to reciprocate (Trivers 1971, Cosmides and Tooby 1989; Fehr and Fischbacher 2003); people who lack functional emotions cannot sustain reliable relationships even when their intelligence is fully intact (Damasio 1994). Consistently, sociologists observe that embeddedness in a network relationship can change the objectives of business transactions from narrow economic goals to maintaining relationships and thus affect the nature of market transactions (Uzzi 1996).

Second, status refers to the "rank ordered relationship among actors describing the interactional inequalities formed from actors' implicit valuations of themselves and one another according to some shared standard of value" (Ridgeway and Walker 2002**:** p.281, Loch et al. 2000). Huberman et al. (2004) experimentally show that subjects intrinsically value a status symbol as an end unto itself, not only as a means to achieve future payoffs. Third, people have an intrinsic tendency to identify with and want to support their peers within groups. Experiments show that subjects systematically favor in-group members, disfavor nonmembers, and strive to maximize the welfare of the group (Tajfel 1970, 1982; Devos et al. 2002).

Furthermore, the field of behavioral economics has developed models of interdependent preferences and empirical tests of social preferences (e.g., Rabin 1993; Fehr and Gächter 2000; Bolton and Ockenfels 2000; Sobel 2005; Charness and Rabin 2002). The experimental results from these models extend the classic self-interested rationality concept (Camerer 1999, Ho et al. 2006) and provide evidence that social preferences may change behavior in economic environments, such as contract markets (e.g., Fehr et al. 1997, 1998).

Following this extended utility approach, Wu and Loch (2006) develop a model of social preferences in a supply chain that suggests social preferences may enable the efficient coordination of the players without a formal incentive contract. We test this theoretical result in a supply chain context and perform controlled experiments in which participants are prompted by direct manipulations to enact their social considerations.

The test of a systematic shift of behavior that is sustained over many sequential interactions is novel. While behavioral economists also experimentally investigate the effect of social preferences on behavior (for example, Charness and Rabin 2003, Fehr et al. 1997, Fehr et al. 1998), their experimental approaches do not systematically vary the salience of relationships and status in controlled experiments, and do not address the sustainability of the effect in repeated interactions over time.

3. Study 1: A Questionnaire Test of Social Preferences in a One-Shot Interaction

Study 1 represents a first test of the effectiveness of the manipulations and the effect of social considerations in a one-shot interaction. The study presents each participant with a hypothetical scenario in which he/she must make a decision that affects his/her own payoff as well as the payoff of a hypothetical other party (for the complete questionnaire text, see the Appendix). The scenarios were given to 100 undergraduate students at a French university in Paris. The participants first read the following base story:

> You own a computer store selling laptops to consumers. At the beginning of each month, you order a certain number of laptops from a wholesaler. You choose the wholesaler among several potential wholesalers, each of whom offers you its unit price. This month, one wholesaler, Mr. Dupont, increases his unit price by 20%, because he needs money to be able to invest in another business opportunity. Mr. Dupont will then start his new business and no longer be a wholesaler for you in the future. Therefore, you will not have any future interactions with Mr. Dupont.

The base story thus is framed as the final interaction between "you" and the hypothetical supplier, Mr. Dupont, so participants do not consider future benefits in their current decision.

The participants then chose between two alternatives: (1) place the same order as they had previously (cooperate): "If you place the same order as before, Mr. Dupont will be able to earn enough money to start his new business, but your profit will be reduced by 30%" or (2) switch to another wholesaler offering the normal price (not cooperate): "If you go to another wholesaler with the normal price, your profit will not be affected." This decision task represents the study's control condition, in which 87% of the participants chose not to cooperate, indicating that the majority of the sample decided rationally.

This percentage changed in the relationship scenario, which also included the following paragraph in the scenario: "Although you will no longer interact with him in the future, you remember that you have a long-standing relationship with Mr. Dupont, and you have worked well together. He has done you favors, and you have done him favors, and you like each other." The relationship manipulation thus is framed in a positive direction. The percentage of respondents choosing not to cooperate shrunk to 38%, and the percent choosing to cooperate increased from 13% to 62% compared with the control scenario. Thus, the perception of a relationship increases willingness to cooperate, even if there is no future interaction value in which to invest.[1]

The group identity scenario provides a similar result. The cue in this scenario is as follows: "Mr. Dupont and you have been known by many others for your previous collaboration. He and you were often referred to as a model group by other wholesalers and retailers in the industry. Although you will not interact with Mr. Dupont in the future, you and he together are known as a successful group." In this scenario, 57% of respondents chose to cooperate, again a statistically significant increase compared with the control condition. This result suggests that a perception of group identity serves as another intrinsic driver of cooperative behavior.

To study the effect of status considerations, we next modified the choice alternatives as follows: (1) cooperate: "If you place the same order as before, Mr. Dupont will be able to earn enough money to start his new business, but your profit will be reduced by 30%" and (2) not cooperate: "If you go to an-

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[1] All comparisons in this section are statistically significant with $p < 0.0001$ in a two-sample Wilcoxon signed rand test.

other wholesaler with the normal price, your profit will be reduced by 40% because that wholesaler has a shortage of supply." The second option results in an inferior economic outcome, so a rational player should choose to cooperate to avoid further profit loss. In the control condition, 97% of the respondents indeed made that choice.

In the status condition, we added the following cues: (1) "If you place the same order as before, Mr. Dupont will be able to earn enough money to start his new business, and your profit will be reduced by 30%. *Moreover, Mr. Dupont will come out as the winner of the interaction. People will say that he has been cleverer and smarter than you*" and (2) "If you go to another wholesaler with the normal price, your profit will be reduced by 40% because that wholesaler has a shortage of supply. *But, because Mr. Dupont loses you as a customer, his loss will be even higher, and you will come out as the winner of the interaction. People will say that you have been cleverer and smarter than he*." The percentage of respondents choosing not to cooperate increased from 3% (in the control) to 27%; that is, these participants pursued status (here, the title "winner"), even though it caused an economic loss for them.

In summary, in the context of social interactions, people may deviate from the predictions of a profit-maximizing agent model. Social preferences affect decisions in a predictable manner, just as other components of the decision maker's utility do. A perceived relationship and perceived group identity foster higher cooperation, even if it reduces the subject's economic benefit. Salient status, in contrast, induces uncooperative actions, even if it results in a lower payoff.[2]

4. Study 2: Experimental Design for Repeated Interactions

The scenarios in Study 1 are hypothetical, lack any real human interactions, and consider only a one-shot transaction without repetition. Therefore, in Study 2, we test the robustness of the effects of social preferences in the presence of real payoffs and repeated transactions.

4.1. The Game

This study consists of a two-player sequential move game in which two participants can interact repeatedly over multiple rounds. The decision task requires that participants choose a profit margin at which to sell a product to a market. In each round, player A (the first mover) chooses his/her margin p_A, and then player B (the second mover) chooses p_B with the knowledge of player A's decision. The two margins jointly determine the market price, $p = p_A + p_B$. Demand q is a linear function of the market price, $q = 16 - p$. To simplify the decision task, we assume the costs of the product are zero. Thus, player A's profit from a single decision round is $\pi_A = p_A(16 - p_A - p_B)$, and player B's is $\pi_B = p_B(16 - p_A - p_B)$.

This game represents decentralized decision making in a business transaction; specifically, it is a simplified version of a well-known supply chain situation in which the supplier asks for a wholesale price (here, p_A), and the retailer responds by choosing its margin (p_B). In addition to the classical wholesaler–retailer structure, the game also can represent a market of two sequential movers selling perfectly substitutable products. Thus, we refer to the players as "first mover" and "second mover" rather than using the specific terms of supplier or retailer.

4.2. Experimental Design: Social Preference Manipulations

We implemented the game with three experimental conditions. In the control condition, two randomly matched participants play the game for 15 rounds with a performance-based payoff as the only incentive. All players are anonymous, separated throughout the study (they interact through computer screens), and prevented from communicating.

The second experimental condition implies a salient relationship; the two players did not know each other when they walked into the lab, but they were given a chance to see each other's face and introduce themselves (exchanging names, shaking hands). This process initiated a relationship, which was reinforced by the following written paragraph handed to each participant before the game started: "You have already met the person with whom you will play the game. Now the person is no longer a stranger

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[2] We also performed a second questionnaire test, in which the participant acts as a supplier to a hypothetical retailer.

to you. You can imagine that the other player is a good friend. You have a good relationship and like each other." This relationship perception is not associated with any economic benefits, and the players made their subsequent decisions separately and without further communication, as in the control condition. Moreover, because they did not actually know each other, they went their separate ways after the experiment, so the perceived relationship had no further effect on their lives.

The third condition makes status salient. A participant is declared the "winner" of a given round if he/she earns a higher profit than his/her partner (the computer screens indicate everyone's payoffs after each round, and the status condition includes a column "winner," in which the participant with the higher profit is highlighted). In tie situations, both are ranked as winners. Again, there are no economic benefits to being a winner, and no one other than the two participants knows who the winner is. Similar to the control condition, the two players are separated throughout the study and do not meet before the end of the game. In addition, no player attempted to find out who the other was; all participants collected their payments at the end and left, without any efforts to find out the identity of their partners.[3]

4.3. Predictions

If the two players are rational profit maximizers, the game has a unique subgame perfect equilibrium. By backward induction, the second mover's best response is $p_B = 8 - p_A/2$, in which case the first mover should choose its optimal strategy $p_A{}^* = 8$. This move determines the second mover's equilibrium strategy, $p_B{}^* = 4$. The market price in equilibrium is $p^* = p_A{}^* + p_B{}^* = 12$, and the realized demand is $q = 4$. The first mover has Stackelberg-leader power and earns twice as much in equilibrium, $\pi_A{}^* = 32$, whereas $\pi_B{}^* = 16$. The decentralized decision making in this game leads to a classic double-marginalization problem, with a channel efficiency of 75%. The socially efficient market price satisfies the condition $p = p_A + p_B = 8$, producing a total profit of 64. Multiple price combinations can lead to full channel efficiency, but at least one player needs to deviate from his/her equilibrium strategy to achieve full system efficiency.

The study produced analogous and similarly significant results.

[3] Unlike in Study 1, we did not implement a group identity condition, because in a two-player experiment, group identity influences a decision maker's actions in the same way a relationship would (Wu and Loch 2006), as we show in Study 1. The separation of group and relationship effects needs replication in larger groups.

Now suppose that the two parties (call them supplier and retailer) have extended utilities, includ-
ing relationship, group identity, and status considerations. The demand function and decision variables
are the same as in our experiment. This model represents player A's utility as

$$U_A = \pi_A + \theta_A \, \pi_B, \tag{1}$$

and player B's utility correspondingly.[4] Here, the parameter θ_A, which represents player A's considera-
tion of player B in round t, is influenced and updated as follows:[5]

$$\theta_{A, t} = \theta_{A, t-1} + \beta \, (p_{B,t-2} - p_{B, t-1}) + \gamma \, (\pi_{A, t-1} - \pi_{B, t-1}). \tag{2}$$

That is, player A feels better about player B if B treats player A nicely by lowering his/her price p_B in the
previous period and if player A has higher status (here, the salient symbol is higher profit) in the last pe-
riod than player B. When we substitute the profit functions into Equation (1) and solve for player A's
optimal equilibrium price, with the extended utility function, we get $p_A^* = (1 - \theta_A)/[(1 - \theta_B) \, (2 - \theta_A \, (1 + \theta_B))]$. Taking the derivative of this price with respect to θ_A shows that the optimal price decreases in the
emotional parameter θ_A. Similarly, player B's optimal price decreases in its emotional parameter θ_B.

Thus, the model predicts that player A's and player B's price decisions should decrease in the
emotional parameters θ_A and θ_B, respectively. Although it is not directly observable in the experiment,
nor is Equation (2), the presence of highly salient relationship considerations should increase θ_A, and the
presence of highly salient status competition should decrease θ_A. Thus, our first prediction is:

Hypothesis 1: Player A's (and analogously, player B's) price decisions across periods should be lower in
the relationship condition and higher in the status condition than in the control condition.

In addition to the effect of the relationship and status manipulations, the effect of θ_A on the optimal pric-
ing decision together with the updating function (2) enables us to predict changes in player A's price de-

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[4] This model is directly based on Wu and Loch (2006), and consistent with previous formulations, for example, Bol-
ton and Ockenfels (2000), Sobel (2005) and Cui et al. (2004).
[5] Wu and Loch (2006) refer to θ_A as the "emotional state."

cision in round t as a function of the prices and profits in the previous period. Equation (2) predicts that the price $p_{A,t}$ is influenced by the action of the other player ($p_{B,t-1}$) and by status (relative profit, i.e., $\pi_{A,\,t-1} - \pi_{B,\,t-1}$) in the previous period through the emotional parameter θ_A. Thus, as we summarize in H2,

Hypothesis 2: Player A's price decision $p_{A,t}$ should increase with player B's price in the previous period and decrease with player A's relative payoff (status) in the previous period; an analogous prediction applies to player B.

4.4. Experimental Procedure

We computerized the game and conducted the experiment using z-tree software (Fischbacher 1999). Participants were randomly assigned to play player A or player B and randomly matched. Players A and B were separated in two rooms, and our recruitment methods ensured that the respondents did not know each other before they entered the lab. The participants were given written instructions and asked to answer some questions to ensure that they understood the instructions. Only if a participant answered the questions correctly could he/she start the experiment. The two participants were told that the game would last, on average, 20 rounds but could be terminated at any time with some level of probability. In the actual experiments, all games were terminated after 15 rounds to avoid potential end-game behaviors. The two participants were located in separate rooms, and each had a computer. In each round, player A moved first, and his/her decision appeared on both screens. Player B then made his/her decision, and the results of the current round were calculated by the software and displayed on both screens, including both prices and profits and, in the status condition, the declaration of the winner. In addition, the history of all previous results appeared on both screens after the second round.

We conducted the experiment in the INSEAD Social Science Research Center in Paris. A total of 168 subjects (84 pairs) participated in our experiments, 28 pairs in each condition. No subject participated in more than one condition. A pair spent, on average, 30 minutes in the study. Participants were students randomly recruited from a university in Paris and possessed varying backgrounds. Their pay-

ment was €1 ($1.28) per 100 points they earned in the experiment. A participant, on average, earned €7 (in the form of vouchers).[6]

5. Results of Study 2

5.1. First Mover Price Decision

The first mover's (player A's) price decisions, averaged over all participants per condition for the 15 rounds, appear in Figure 1. In all conditions, the only tangible incentive is the performance-based payoff. Thus, a rational participant should choose the equilibrium price $p_A^* = 8$. The curves suggest that in each condition, equilibrium is reached quickly, so the hypothesis that the average prices change over the course of the 15 rounds can be statistically rejected (details not shown).

In all three experimental conditions, even the control, the average first mover price is lower than the rational price, a result we discuss further in Section 5.3. Comparing prices across the three conditions, we find they are lower in the relationship condition than in the control condition ($p < 0.0001$ by the non-parametric [distribution independent] Mann-Whitney two-tailed test for the three averages of the experimental conditions), and prices in the status condition are higher than in the control condition ($p = 0.004$).
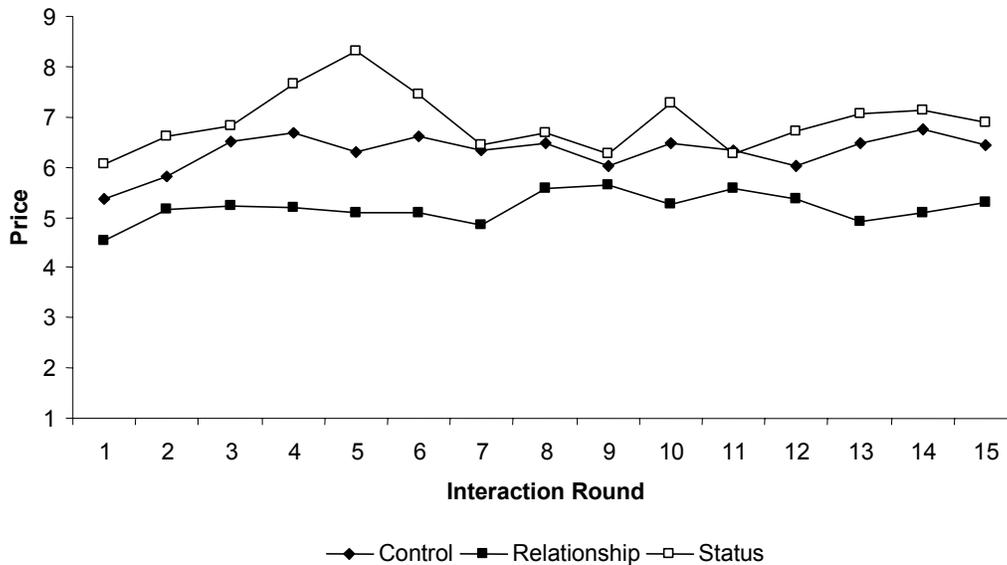

Figure 1: First mover price decisions over 15 rounds and across conditions

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[6] Cash payments are illegal in France without a formal work contract and thus are impractical in an experiment.

In the relationship condition, participants were cued to assume a good relationship with the other side (though they clearly would have no interactions after the experiment was over). As we demonstrate with Figure 1, the first mover charged a lower price here than the control condition. A lower price p_A is beneficial to player B and puts player A in a vulnerable position, because there is no guarantee that player B will not take advantage of this situation to player A's disadvantage.

Participants acted more competitively in the status condition, when "winning" was at stake. Prices in the status condition are the highest among the three conditions. Moreover, a higher price leaves less room for the second mover to respond, which increases player A's chance of earning more (i.e., winning) than the other side.

As we mentioned previously, the manipulations have an effect from the first period on, when a trading history has yet to be established. We find that "nice" and "tough" actions do not weaken over time. Maintaining such consistent pricing depends on the other side's responses, as we examine in the next section.

5.2. Second Mover Price Decision

In Figure 2a, the second mover's prices exhibit the same pattern as the first mover's; that is, they are lower in the relationship condition than in the control condition ($p = 0.001$, nonparametric, Mann-Whitney two-tailed test) and higher in the status condition than in the control condition ($p = 0.013$).

Because the second mover always makes his/her decision after observing the first mover's price, he/she reacts to the first mover. Figure 2b shows that in the control condition, player B is somewhat more aggressive than the rational best response would imply ($p < 0.0001$, Mann-Whitney two-tailed test; see also discussion in Section 5.1). The best response price, defined by the price that maximizes profit, is given by $p_B^* = 8 - p_A/2$. However, in the relationship condition, player B consistently remains below his/her rational best response ($p = 0.0001$); that is, player B does not exploit player A's "nicety."
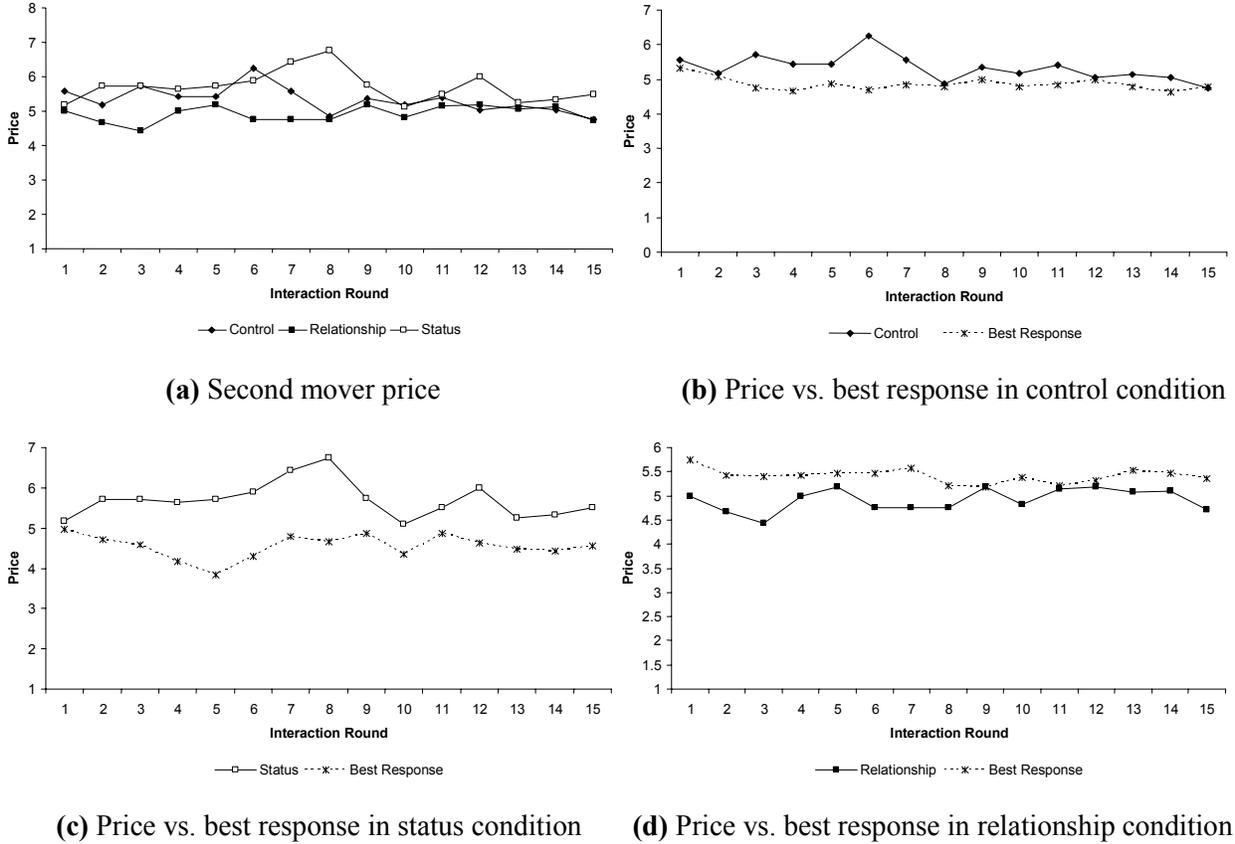
(a) Second mover price

(b) Price vs. best response in control condition

(c) Price vs. best response in status condition

(d) Price vs. best response in relationship condition

Figure 2: Second mover price and comparisons with best response price

In the status condition, in contrast, player B's response is consistently much higher than the best response (Figure 2d; $p = 0.0001$), and p_B is above the price in the control (see Figure 1), though player A's price is higher (and thus a lower response would be rational). The higher price clearly lowers the second mover's profit, but it may increase the chance of becoming a winner because it also reduces the first mover's profit. If we take into consideration that the title "winner" was revealed only to the two involved players, who do not even see each other's faces, the pricing decision pattern suggests, consistent with previous work (e.g., Huberman et al. 2004), that status is pursued as an end in itself.

Moreover, across all three conditions, we find that the second mover's price correlates positively with the first mover's price. This behavior contradicts the second mover's rational behavior in equilibrium, which would require a negative correlation (the second mover yielding to a higher price of the first mover). Thus, the social preference manipulation changes the nature of the rational game.

5.3. Profits

Both players earn a higher payoff in the reciprocity condition and a lower payoff in the status condition compared with the control condition, as we illustrate in Figures 3 and 4. All differences are significant (all $p < 0.005$, Mann-Whitney two-tailed test). In the relationship condition, the first mover's low price pays off because the second mover reciprocates with a lower price. As we discussed in the previous section, the second mover does not exploit the first mover by choosing the best response price but rather a lower price. In hindsight, this decision pattern is mutually beneficial; in each round however, each player deviates from economic rationality because each could do better individually by behaving more aggressively.
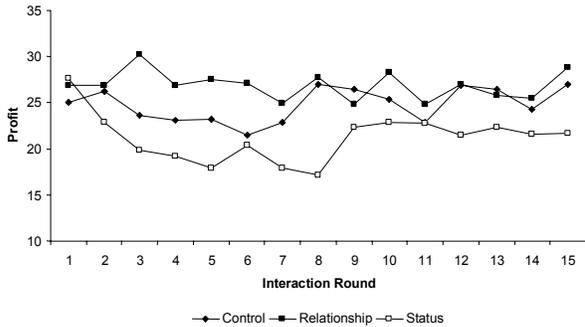

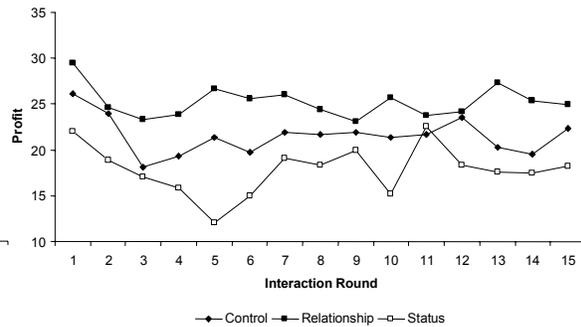**Figure 3**: First mover profits over 15 rounds   **Figure 4**: Second mover profits over 15 rounds

The status consideration, in contrast, induces tough actions on both sides and reduces overall profits. A player may receive the "winner" designation in a certain round, but it comes at an economic cost for both. The first mover still enjoys a first-mover advantage (earning more than the second mover), but overall performance is lower than in the control condition. The second mover responds by charging a higher price than the best response, damaging his/her own profit as well. In contrast to the reciprocity condition, both players suffer economically.

   After observing the increased profits in the relationship condition (Figures 3 and 4), we consider the alternative explanation that the two players may "think ahead" and deviate from short-term rationality (prices are too low in each round) not because of social preferences but to achieve long-term rationality (both are better off over time by sustaining collaboration). However, the status condition eliminates this

alternative explanation, because both players deviate from both short- and long-term rationality. Thus, the only explanation for the results of both conditions is that players pursue relationship and status in their own rights, their utilities extending economic rationality.

A side observation is that the two profits, even in the control condition, are not distributed as predicted by the Nash equilibrium, according to which the first mover should earn twice as much (32) as the second mover (16). The average earnings of the first mover are lower, and those of the second mover higher, resulting in a more balanced profit allocation, because player A is a bit less aggressive and player B more aggressive than predicted in the rational analysis (see also Section 5.1). Keser and Paleologo (2004) observe a similar phenomenon in their wholesaler–newsvendor retailer experiment. This outcome also might be explained by social considerations; participants may start the experiment already expecting some degree of relationship and fairness considerations, even in the anonymous control condition. Further work is needed to examine the minimal conditions for fairness and relationship concerns.

5.4. Economic Efficiency

As we have discussed, it is well know in supply chain contracting literature that a system of two decentralized decision makers is not economically efficient; double marginalization leads to a normally expected efficiency of 75%. Our results are consistent with this expectation in the control condition, as we show in Figure 5. The efficiency in the control condition is not significantly different from 75% at the 5% level ($p = 0.334$, Mann-Whitney two tailed test, with averages as individual observations). Average efficiency in the relationship condition is higher than in the control condition ($p < 0.0001$) and than 75% ($p < 0.0001$). In contrast, the status-seeking condition results in low efficiency compared with the control ($p < 0.0001$) and lower than 75% ($p < 0.0001$).

A more detailed examination of the individual observations illustrates the differences in economic efficiency in a different way. Each condition includes 420 total transactions. In the control condition, full system efficiency occurs in 31 cases. In the reciprocity condition, 102 cases achieved full efficiency, and in the status condition, full efficiency occurs only in 9 cases.
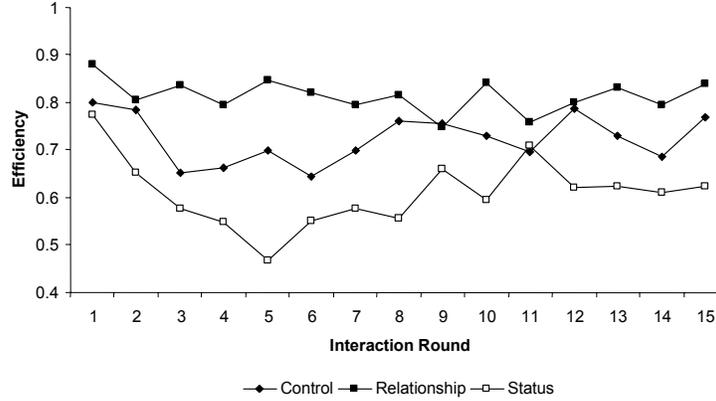
Figure 5: Economic efficiency for the dyad over 15 rounds

5.5. Test of Hypothesis 2: Per-Round Influences on Prices

To test the predicted dynamics of the pricing decisions (hypothesis 2), we use an ordered logit analysis, in which we treat choices as ordinal categorical data. Players had to choose whole numbers as prices, and thus, the continuity assumption of ordinary least squares regression is violated; the decision variables are indeed ordinal.[7] Since players chose prices above 9 and below 3 only in a small number of cases, we group the prices less than and equal to 3 as one choice, and the prices greater than and equal to 9 as one choice. We use the partial proportional odds model (Peterson and Harrell 1990, Richard 2006), which represents our data structure. The proportional odds logit model that reflects the hypothesized (H2) influence of previous period's decisions on player A's period *t* price is

$$\text{logit}\ [P(p_{A,t} > j)] = \alpha_j + \beta_1\, p_{B,t-1} + \beta_2\, (\pi_{A,\,t-1} - \pi_{B,\,t-1}) + \beta_3\, R + \beta_4\, S,\quad j = 3,\ ...,\ 8.$$

R and *S* are dummies capturing the relationship and status conditions, respectively (each is set to 1 in its condition and 0 otherwise); they repeat hypothesis 1. The model reflects (consistent with Equation (2) in Section 4.3) that people (emotionally) respond to social interactions in a backward- rather than forward-looking manner: a player updates his/her emotional parameters on the basis of past interactions. This is captured by the lagged variables $p_{B,t-1}$ (previous period price of player B) and $(\pi_{A,\,t-1} - \pi_{B,\,t-1})$ (previous period's relative profits, capturing status). Similarly, the logit model for player B's response is given by

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[7] If there were many choices (e.g., prices varied between 0 and 100), the dependent variable reasonably could be regarded as approximately continuous. However, most prices are between 3 and 9, too far from continuity.

$$\text{logit } [P(p_{B,t} > j)] = \alpha_j + \beta_0\, p_{A,t} + \beta_1\, p_{A,t-1} + \beta_2\,(\pi_{B,\,t-1} - \pi_{A,\,t-1}) + \beta_3\, R + \beta_4\, S, \quad j = 3, ..., 8.$$

Here, player A's current price $p_{A,t}$ is included as an additional predictor, because player B makes his/her choice with the knowledge of A's current price. The "economically rational" response by player B is to yield (reduce his/her price) in response to a higher price by player A.

It turns out that the logit analysis rejects the assumption that the parameters β_2 and β_4 are constant across price levels j for player A, and that β_0, β_3, and β_4 are constant across j for player B. The parameters need to vary across price levels, that is, they must be indexed by the price group index j. Thus, these parameters have different estimates for the seven price groupings 1…3, 4, 5, 6, 7, 8, and 9…15. For ease of exposition, to reduce the complexity for the reader of wading through a table with all these parameter estimates, we report the estimates for the two players in graphical form in Figure 6. Here, we only focus on the signs of the coefficient of each independent variable to interpret its effect. Detailed statistical results with the sizes of the coefficient estimates and the precise significance levels are reported in Appendix A.

Player A (upper chart in Figure 6) increases his/her price in the status condition and decreases it in the relationship condition (this formally supports the discussions in Section 5.1). Moreover, player A increases his/her price in retaliation upon a higher previous period price of player B and in response to a higher relative payoff. This supports hypothesis 2: the status concern (here, last period's relative payoff) plays a significant role in players' prices, as we predicted. However, the effect is opposite our prediction; the coefficient is positive, which implies that higher status in the previous period induces a *higher* price choice. The participants clearly care about status, but whereas we hypothesized that a player with high status would "relax" and be willing to give in on price, the player actually pursues and defends his/her status even more aggressively. Having status thus appears to whet the appetite and motivate further status seeking.

The status condition and last period's relative payoff effects are insignificant when player A chooses a very low price (1…4): there were only few instances of such low prices, driven by different concerns.
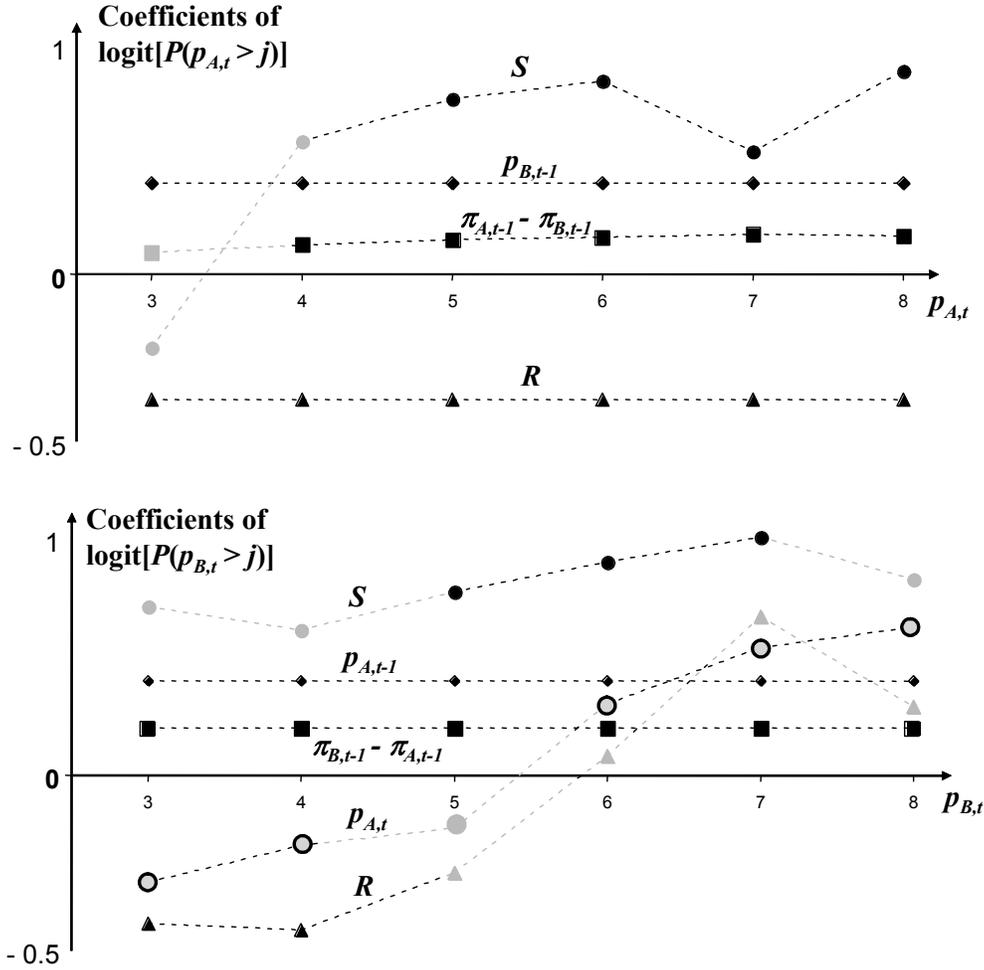
Notes: The curves denote the estimates of the parameters β_{xj} associated with the respective variable x (indicated for each curve) and the respective player's price decision p_{At} and p_{Bt} (indicated on the horizontal axis). The points in black are statistically different from zero at a significance level of less than 5%; the points shaded gray are not statistically different from zero.

Figure 6. Logit Analyses of the Dyamics of Price Choice Over Time

Player B's price dynamics (lower part of Figure 6) are more complicated than player A's because player

B, as the second mover, reacts to the current price of player A in addition to the other variables. The ef-

fects of the status condition, player A's last period price and last period's relative payoffs all increase

player B's price decision, consistent with the results for player A. Again, more status in the form of rela-

tive payoff prompts the player to want more status and become more aggressive. Moreover, both players'

responses to each other's past prices exhibit reciprocation; subsequent prices are positively correlated

(rather than negatively correlated as resulting from an economically rational response). These results support hypothesis 2.

Player B responds to the presence of a relationship manipulation only while setting relatively low price $j=1...4$). When player B sets a higher price, he/she disregards the presence of a relationship (the coefficient associated with the dummy R is insignificant). Tough action negates the consideration of a relationship, or occurs when the player does no care about the relationship.

Finally, player B responds rationally to a higher current price p_{At} of the first mover by reducing his/her own price, but only at relatively low prices ($\beta_{1,j}$ negative for j <= 5). Whenever player B sets a higher price, he/she responds with an *increased* price to a higher price of player A ($\beta_{1,j}$ positive for j > 5). The high price may act as a punishment for player A's high price or as a device to pursue a higher relative payoff. This non-monotonic result shows how social preferences and economic (rational) goals interact. The players recognize that they may lose payoff by being too aggressive and thus exhibit behavior consistent with profit maximization. However, when the player is being aggressive, economic rationality is outweighed by status effects of pricing decisions. This implies that they deviate from pure economic rationality not because they are boundedly rational (in plain English, "too stupid"), but because social preferences, in addition to payoffs, influence their behavior.

6. Concluding Remarks

Social considerations, such as relationships, status seeking, and group solidarity, have been extensively studied in social sciences. Research in psychology and sociology suggests that human beings pursue those social considerations as ends unto themselves,[8] but most supply chain contracting literature has focused on self-interested rational agents and ignored social considerations.

Recent experimental tests suggest the limited predictive power of rational agent models for contracting behavior (Katok and Wu 2006) and point to the cognitive biases missing in contracting theory

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[8] Evidence suggests universal psychological motivating mechanisms, although the triggers and the relative weights of social preferences vary individually and by culture (Fiske 2002; Loch et al. 2006).

(Ho and Zhang 2005, Lim 2004). We design a controlled experiment to examine the effect of social preferences, rather than cognitive biases, on behaviors in contracting situations. In particular, we make salient relationship and status-seeking considerations, as compared with a control condition that focuses on economic incentives only (i.e., we experimentally separate social preferences from economic motives). To our knowledge, no previous work has studied empirically how social preferences affect performance in supply-chain–like contracts.

Our game has the same structure as a linear contract between a wholesaler and a retailer, in which the wholesaler sets a unit wholesale price, and then the retailer chooses its order quantity and market price. Although in our experiment, the second mover chooses a margin, it is equivalent to an order quantity or market price because demand is linear.

Our experimental results reveal large and sustained effects of social preferences on decision making in business transactions. Subjects consistently deviate from rational, profit-maximizing behavior in all conditions, which suggests that the social preferences can shift the equilibrium behavior. Moreover, the second mover's prices exhibit a positive correlation with the first mover's prices, in opposition to the economic model of rational decision makers, which posits that the second mover has no credible counteraction after an aggressive first mover's action and therefore should give in, whereas it should exploit a "too low" first mover price by increasing its price. This economic logic is violated systematically in our experiment.

Specifically, the relationship condition prompts first movers to offer a low price, and the second movers do not exploit this low price but in turn offer a low price of their own. As a result, the pair deviates from economic maximization but manages to sustain behavior that significantly improves profits as well as overall efficiency. However, the reason is not economic forward thinking; as the status condition shows, subjects also deviate from economic rationality in a way that clearly causes them economic harm so that they may pursue their social preferences, in addition to and separate from economic motives. The relationship setup in our experiment is a very weak manipulation, because there was no real interaction before participants entered the lab (i.e., just a handshake and name exchange) and no future interactions

after participants leave. And yet, the observed effect is considerable in magnitude, which suggests high robustness.

In the status condition, first and second mover price decisions are correlated because when player A sets an aggressive price, player B responds with an equally aggressive price, which means it gives up substantial profits to deny player A status (being the winner). The status symbol is private, fleeting, and has no future value, yet both players settle into competitive behavior to the point that both profits and overall efficiency are substantially compromised. Again, the manipulation is weak, and yet the effect is considerable in size and robust.

Our results thus offer two theoretical contributions. First, we demonstrate that social preferences that emerge in other contexts (e.g., experimental economics, anthropology, psychology) also influence behavior in (supply chain) contracting situations. Moreover, social preferences matter for performance—a perceived relationship can induce collaborative behavior and enhance performance, whereas perceived competition for status can induce competitive behavior and hinder performance. Second, we test a particular model of social preferences as part of the decision maker's utility function and find considerable support for the idea that the experience of "friendly" behavior by the other side, as well as the experience of status gained or denied, influences attitudes and thus the utility each actor pursues in a given interaction. With the extended utility, equilibrium behavior shifts.

Our results also have several managerial implications. First, social preferences act as motivators that can have the same effects on individual behavior as economic incentives. In other words, standard incentive systems (e.g., bonuses, rebates, profit sharing) are incomplete as an arsenal to influence agents' behavior. Second, relationship emphasis and status competition are emotional incentives with very different, and sometimes opposite, effects. Salient relationship may serve as additional motivation to collaborate, which can significantly enhance the efficiency of supply chain coordination. Relationships can act as (partial) complements to formal incentive contracts; other recent experimental work also suggests that social preferences may be as or more effective than formal contracts.

Status, however, seems a dangerous instrument to use within partnerships. Although a strong motivator, it prompts individual effort and performance, which may reduce group or partnership performance whenever two parties are interdependent. Therefore, status symbols might be work well to emphasize competition with external parties but should not be used within the group or partnership. Although such considerations for managers have been discussed previously, they have not been rigorously tested on the basis of a model of social preferences with individual utility.

As a first step to study social preferences experimentally in the context of supply chain contracts, our study prompts several additional research questions: How can the negative effect of status seeking on performance be mitigated? What are the fundamental drivers of deviations from economic rationality (i.e., more balanced profit allocation), even in the control condition? This question is particularly pertinent, as we are not the only ones to observe the deviation. In addition, we do not test the effect of group identity in Study 2, because group identity and relationships are interlinked and one often leads to the other. However, further research might consider how group identity and relationship preferences can be disentangled experimentally to study their interactive dynamics in a decentralized decision-making situation. Providing empirical answers to these questions would not only offer theoretically pleasing analyses of supply chain coordination but also suggest ways to manage it more effectively in practice.

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Appendix A. Ordered Logit Analyses Studying the Dynamics of Price Choice Over Time

We report the detailed statistical results of the partial proportional odds models in section 5.5. The estimates are obtained by the generalized ordered logit estimate program "gologit2" in Stata (Richard 2006).

Variables	Player A' Price $p_{A,t}$	Variables	Player B' Price $p_{B,t}$
$j = 3$		**$j = 3$**	
		A's current price $p_{A,t}$	-0.3446*** (0.0363)
B's last price $p_{B,t-1}$	0.1876*** (0.0336)	A's last period price $p_{A,t-1}$	0.1864*** (0.0328)
A's last relative payoff		B's last relative payoff	
$(\pi_{A,t-1} - \pi_{B,t-1})$	0.0027 (0.0083)	$(\pi_{B,t-1} - \pi_{A,t-1})$	0.0385*** (0.0054)
Relationship R	-0.8314*** (0.1295)	Relationship R	-0.6884*** (0.2056)
Status S	-0.1758 (0.2676)	Status S	0.2866 (0.2004)
Constance	1.8961*** (0.2337)	Constance	3.0561*** (0.3277)
$j = 4$		**$j = 4$**	
		A's current price $p_{A,t}$	-0.2033*** (0.0315)
B's last price $p_{B,t-1}$	0.1876*** (0.0336)	A's last period price $p_{A,t-1}$	0.1864*** (0.0328)
A's last relative payoff		B's last relative payoff	
$(\pi_{A,t-1} - \pi_{B,t-1})$	0.0199*** (0.0063)	$(\pi_{B,t-1} - \pi_{A,t-1})$	0.0385*** (0.0054)
Relationship R	-0.8314*** (0.1295)	Relationship R	-0.7935*** (0.1566)
Status S	0.3182 (0.1814)	Status S	0.1823 (0.1548)
Constance	0.3801 (0.2125)	Constance	1.01855*** (0.2659)
$j = 5$		**$j = 5$**	
		A's current price $p_{A,t}$	-0.0306 (0.0310)
B's last price $p_{B,t-1}$	0.1876*** (0.0336)	A's last period price $p_{A,t-1}$	0.1864*** (0.0328)
A's last relative payoff		B's last relative payoff	
$(\pi_{A,t-1} - \pi_{B,t-1})$	0.0320*** (0.0058)	$(\pi_{B,t-1} - \pi_{A,t-1})$	0.0385*** (0.0054)
Relationship R	-0.8314*** (0.1295)	Relationship R	-0.2220 (0.1523)
Status S	0.4197** (0.1508)	Status S	0.4000** (0.1450)
Constance	-0.6205 ** (0.2131)	Constance	-1.2479*** (0.2610)
$j = 6$		**$j = 6$**	
		A's current price $p_{A,t}$	0.0846* (0.0331)
B's last price $p_{B,t-1}$	0.1876*** (0.0336)	A's last period price $p_{A,t-1}$	0.1864*** (0.0328)
A's last relative payoff		B's last relative payoff	
$(\pi_{A,t-1} - \pi_{B,t-1})$	0.0383*** (0.0059)	$(\pi_{B,t-1} - \pi_{A,t-1})$	0.0385*** (0.0054)
Relationship R	-0.8314*** (0.1295)	Relationship R	0.0144 (0.1793)
Status S	0.4624*** (0.1418)	Status S	0.6188*** (0.1634)
Constance	-1.4196*** (0.2182)	Constance	-2.9389*** (0.2849)
$j = 7$		**$j = 7$**	
		A's current price $p_{A,t}$	0.2126*** (0.0476)
B's last price $p_{B,t-1}$	0.1876*** (0.0336)	A's last period price $p_{A,t-1}$	0.1864*** (0.0328)
A's last relative payoff		B's last relative payoff	
$(\pi_{A,t-1} - \pi_{B,t-1})$	0.0448*** (0.0063)	$(\pi_{B,t-1} - \pi_{A,t-1})$	0.0385*** (0.0054)
Relationship R	-0.8314*** (0.1295)	Relationship R	0.3338 (0.2353)
Status S	0.2934* (0.1477)	Status S	0.7455*** (0.2126)
Constance	-2.048*** (0.2253)	Constance	-4.7518*** (0.3958)
$j = 8$		**$j = 8$:** A's current price $p_{A,t}$	0.3391*** (0.0727)
B's last price $p_{B,t-1}$	0.1876*** (0.0336)	A's last period price $p_{A,t-1}$	0.1864*** (0.0328)
A's last relative payoff		B's last relative payoff	
$(\pi_{A,t-1} - \pi_{B,t-1})$	0.0421*** (0.0072)	$(\pi_{B,t-1} - \pi_{A,t-1})$	0.0385*** (0.0054)
Relationship R	-0.8314*** (0.1295)	Relationship R	0.1576 (0.3320)
Status S	0.5658** (0.1822)	Status S	0.3490 (0.2958)
Constance	-3.1029*** (0.2447)	Constance	-6.3640*** (0.5998)
Wald test for $\beta = 0$:	$\chi^2(14) = 186.46$***		$\chi^2(20) = 288.55$
Wald test for proportional odds assumption:	$\chi^2(10) = 12.65$ $p > \chi^2 = 0.2438$		$\chi^2(10) = 12.07$ $p > \chi^2 = 0.2806$

Notes: Number of observations: N = 1176. * *p<0.05*; ** *p<0.01*; *** *p<0.001*. Standard errors are in parenthesis besides the estimates. An insignificant test statistic for propositional odds assumption indicates that our partial proportional odds models do not violate the proportional odds assumption.

Appendix B. Instructions

The original instructions were in French. The following instructions are for Player A in the control condition; the instructions for Player B are analogous.

Welcome to this study on decision making in markets. In the study, you will be **randomly** matched with some other player (Player B hereafter). You will play a game with **that same player** many times. The rules of the game are simple. If you follow them carefully and make appropriate decisions, you may earn a considerable amount of money (in the form of vouchers). Your earnings depend on your decisions and Player B's decisions.

The Game

You will play with Player B over several rounds. In each round, you and Player B sell products to a buyer. The product has two parts, part A delivered by you and part B delivered by Player B. The buyer buys both parts as ONE product (either part alone is worthless to him/her). You move first and decide on a price for your part (*your price* in points) to sell one unit product to the buyer. Knowing your price, Player B then makes a decision on her/his price (*Player B's price* in points). The price of the complete product to the buyer is the sum of your price and Player B's price (*Product's Price = your price + Player B's price*). The amount of the product that the buyer will buy depends on the product's price. As you can imagine from your experience, if the product's price is high, the buyer will buy fewer units of your product. If the product's price is lower, the buyer is willing to buy more units of the product. The relationship between the price and the units you can sell to the buyer is given in the following table.

Product's Price (*Your price +Player B's price*)	Units Sold (Units the buyer will buy)
1	15
2	14
3	13
4	12
5	11
6	10
7	9
8	8
9	7
10	6
11	5
12	4
13	3
14	2
15	1
16 or greater than 16	0

For example, if the price is 6, the buyer will buy 10 units. If the price is 11, the buyer will buy 5 units. If the price is equal to or greater than 16, the buyer considers it too high and will not buy any units. In this case, both you and player B earn zero points.

In each round, your earnings are equal to (*your price*) × (*units sold*), i.e., your price times the units the buyer buys; Player B's earnings are equal to (*Player B's price*) × (*units sold*), i.e., Player B's price times the units the buyer buys. As you can see, your earnings are determined not only by your decision but also by Player B' decision, because the units that the buyer buys depend on both your and Player B's price.

You will make your decision on the computer in front of you. Your price will be shown to Player B. After Player B knows your decision, s/he will decide on her/his price, which will be shown to you on your screen. Your earnings and Player B's earnings will be calculated and shown to both of you on your screens. In addition, all past records of your decisions and earnings will be displayed to both of you.

The game will be stopped after a random number of rounds (but on average, there will be 20 decision rounds). Your role stays the same for all rounds. At the end of the study, all your earnings will be added and your overall payment will be 0.1€ per 10 points of your total earnings, which will be paid in the form of vouchers.

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