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Abstract:

Recent experimental research has shown that when rating systems are available, buyers are more generous in accepting unfair offers made by sellers. It has also shown that sellers make fairer decisions when they are rated, while some studies show that they are little affected by the rating systems. These studies are conducted under complete information settings. However, asymmetric information about the values of traded commodities between sellers and buyers may change their perception of fairness and thus may change sellers' decisions. We conduct ultimatum game experiments in which only the sellers are informed of the size of pies. We find that when rating systems are available to the buyers, the buyers become more amenable to potentially unfair offers. We also find that sellers attempt to sell the commodity at higher prices, taking advantage of the buyers' openness to potentially unfair offers, contrary to the past studies with complete information.

Keywords: Experiments, Ultimatum Game, Incomplete Information, Emotion, Rating, Social Approval, Social Disapproval.

JEL classification codes: C91, D03, D82, M21

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Research highlights

- We experimentally study ultimatum games where only the sellers are informed of the size of the pie.
- The buyers are more open to potentially unfair offers when they are given opportunities to rate their matched sellers.
- The sellers make more unfair offers when the buyers are given opportunities to rate them.

1. Introduction

Imagine that you have an old car that you would like to sell and that only you know its true value. Suppose that a person, a stranger to you, is considering purchasing a used car. Moreover, suppose that there is a law that demands you make yourself available to the buyer for one year so that you can receive comments or complaints after you sell the car to her. How do you think you would set the price of your car to the potential buyer? Would the presence of such a feedback system cause you to behave in a fairer manner, as you will want to avoid receiving criticism from the buyer? Or, would you try to sell it at a more unfair price, as you expect, for example, that your feelings of obligation to behave fairly may diminish as you can instead listen to criticism from the buyer, or that the buyer may trust you more because of the feedback system?

In recent decades, economists have devoted effort to studying the impact of expressing emotion on people's behavior under complete information settings, and have found that emotional expression may affect both senders and recipients. On the one hand, it has been documented that people have preferences against receiving disapproval from others and consequently they behave pro-socially so that they do not receive negative feedback. For instance, in a standard linear public goods game where full free-riding is a strictly dominant strategy, when subjects are given an opportunity to give social approval or disapproval points to each other, the recipients of social disapproval are more likely to raise contributions (e.g., Masclet *et al.* 2003, Dugar 2011). In a dictator game, dictators are less likely to make an unfair division of a pie when receivers have ex-post opportunities to express emotion to their dictators (e.g., Ellingsen and Johannesson 2008, Xiao and Houser 2009).[1] In a prisoner's dilemma game, subjects are more likely to cooperate if they are given an ex-post opportunity to send a message to their partners at their own expense (e.g., López-Pérez and Vorsatz 2010). On the other hand, expressing emotion has also been known to affect the behavior of senders of emotion as well, as expressing emotion can be considered as a substitute of being engaged in real actions. For example, in ultimatum games, buyers (responders) are more likely to accept unfair offers, when given opportunities to express emotion (e.g., Xiao and Houser 2005, Güth and Levati 2007). This suggests that expressing negative emotion is a substitute for punishing their matched sellers (proposers) or perhaps even for obtaining a fair deal.

[1] In an ultimatum game the same does not hold: the percentage of unfair offers only insignificantly decreases (e.g., Xiao and Houser 2005, Güth and Levati 2007).

In this paper, we study the effects of expressing emotion by conducting an ultimatum game experiment in which only the sellers are informed of the size of a pie (incomplete information). Our purpose is to propose and explore the idea that opportunities for expressing emotion may adversely affect the behavior of those who receive emotion in this environment. This hypothesis is counter-intuitive to some degree and appears to contradict the aforementioned recent findings on the significance of the disapproval-averse preferences under complete information settings. However, since the presence of an institution on which emotion is conveyed gives an individual an option of simply receiving negative emotion or criticism rather than feeling obligated to behave in an acceptable manner and actually doing so, motivation to act fairly may be crowded out and selfish behavior may instead be stimulated when such an institution is present. Accordingly, if the emotional expression generates the negative effect, which we call the "fairness crowding-out effect," and if it is stronger than the disapproval-averse motive, then we can expect that the recipients of emotion may behave more selfishly. As a result, the emotional expressing opportunities can be more adverse to those expressing emotion.

Understanding the effects of expressing emotion under the asymmetric information setting is especially important for two reasons. First, the incomplete information setup is more realistic in some circumstances, including the example of the used car in the market mentioned above. Second, the asymmetric information between sellers and buyers may significantly change their perceptions of fairness. While many experiments have demonstrated that people have preferences for fair outcomes in ultimatum games with complete information (see Roth (1995) for a survey), some studies have also shown that sellers can become greedier and their offering prices may be close to the ones that the standard theory predicts in incomplete information setups (e.g., Straub and Murnighan 1995, Rapoport *et al.* 1996, Croson 1996, Güth *et al.* 1996, Mitzkewitz and Nagel 1993). If the fairness crowding-out mentioned above is prevalent as we conjecture, and if the relative strength between the two countervailing effects depends on the information condition, then we may observe a more materially beneficial effect of a rating system on individuals who are rated unlike the findings of the previous studies, as selfish behavior triggered by the fairness crowding-out may be greater than the disapproval aversion under incomplete information.

Our experimental design is straightforward. Each subject is randomly divided into either the role of seller or that of buyer. Each seller has one commodity whose value is randomly drawn from integers between 0 and 40, and is randomly matched with a buyer. Sellers submit their offering prices, and buyers submit their purchase thresholds. If a seller's offering price is less than or equal to his or her matched buyer's purchase threshold, then, the deal is closed. In some treatments, buyers are given opportunities to rate their matched sellers on a 10-point scale after learning their transaction outcomes. Our data clearly indicates that the buyers on average submit higher purchase thresholds when they are given ex-post opportunities to rate their sellers. This finding is consistent with the results of recent ultimatum game experiments with complete information and implies that expressing emotion can be a substitute for rejecting offers for the buyers. However, we find that with the rating system, the sellers on average set higher prices for each randomly drawn value of commodities, which is a new finding. This suggests that receiving bad ratings and criticism can be a substitute for behaving in a fair manner; and selfish behavior triggered by the fairness crowding-out may be stronger than the disapproval-averse effect under incomplete information settings, unlike under complete information settings.

The rest of the paper proceeds as follows: Section 2 describes our experimental design. Section 3 provides theoretical predictions. Section 4 reports results, and Section 5 concludes.

2. Experimental Design

Our basic framework is a set of finitely repeated ultimatum games with incomplete information on the buyers' side. The quality of the commodity traded between the sellers and the buyers is only known to the sellers. The number of periods is 50 and there is no break between rounds. Each interaction unit (group) includes ten subjects. Subjects do not interact with subjects in other groups. At the onset of the experiment, a group of ten subjects is randomly divided into two subgroups of five subjects. Then, five subjects in one subgroup are assigned roles of seller (proposer) and the five in the other subgroup are assigned roles of buyer (responder).[2] The initially assigned roles are not changed throughout the entire session. The number of periods in the experiment and the assignment procedure of the roles are common knowledge of all the subjects.

In each period, each seller is randomly matched with a buyer in his or her group. Since there are five buyers and five sellers in a group, the probability that a seller is matched with the same buyer both in period t and period $t-1$ is 20%. In each round, each seller has one commodity

[2] In the experimental sessions, two subsets of subjects are called "buyers" and "sellers" as written in the paper. The framing of buyers and sellers is often used in experiments with ultimatum games (e.g., Roth *et al.* 1991).

whose quality is the same across all five sellers in his or her group. The quality (true value) of the commodity, q_t, is randomly drawn from the set of integers ranging from 0 to 40 every period. This means that each integer is realized at a probability of 1/41. The random drawing process is independent across periods, and the distribution of q_t is common knowledge of all subjects. However, only sellers learn the realized value of the commodity. In other words, q_t is the private information of the sellers. This set-up is similar to the experimental design of ultimatum games with incomplete information such as Rapoport *et al.* (1995). For example, in Rapoport *et al.*, the size of the pie in an ultimatum game is randomly distributed from a uniform distribution [a, b] and the realized size is the private information of the sellers.

The decisions that our subjects make in the experiment are similar to the ones in a standard strategy method ultimatum game. Each seller will propose a price p_{sj} to sell a commodity to his or her matched buyer. They can sell at most one commodity. p_{sj} must be an integer ranging from 0 to 40. Each buyer, by contrast, simultaneously submits a purchase threshold p_{bi} to his or her matched seller.[3] If $p_{sj} \le p_{bi}$, a deal is closed between i and j; the seller obtains a payoff of $p_{sj} - q_t/2$, and the buyer obtains a payoff of $q_t - p_{sj}$. Here, $q_t/2$ is recognized as the production cost of a commodity or the value of it for the seller. If $p_{sj} > p_{bi}$, then a deal is not closed; the payoffs of both players are zero in the period. Note that when a deal is closed, if $q_t - p_{sj} < 0$, the buyer incurs a loss. The buyers learn the realized value of the commodity (q_t) at the end of each period. Subjects are paid based on the sum of their own payoffs earned during all 50 periods.[4]

We vary treatments by rating opportunities to buyers. In the "No Information, No Rating" treatment, abbreviated as N treatment, subjects play the aforementioned game 50 times. This treatment is a baseline treatment in this study. In the Rating treatment, dubbed as R treatment, each buyer is given an opportunity to rate their matched seller on a 10-point scale every round after learning their transaction outcome including their own payoff and their matched seller's payoff. Buyers are instructed that the lowest number, 0, means "very unfair;" 3 means "unfair;" 7 means "fair;" and the highest number, 10, means "very fair." While the buyers are making their rating decisions, the sellers are asked to submit a price that they would offer if they had a second chance

[3] Strategy methods are widely used in experiments with ultimatum games. The benefit of using the strategy methods is to elicit the upper bound of the buyer's purchase (acceptance) decisions. With the standard, sequential direct-response method, we only observe a buyer's acceptance decision to a specific offer, not the threshold. Past studies find little difference in behavior between the two methods when used in ultimatum games with incomplete information on the buyer's side (see Brandts and Charness 2011 for a survey).
[4] \$5 is guaranteed for their participation in case their accumulated payoff is less than \$5.

to sell the commodity whose value was the same as the current value. The questionnaire to the seller is hypothetical and non-incentivized.[5]

In addition to the N and R treatments, we also conduct the Social Information treatment, dubbed as SI treatment, and the "Social Information and Rating" treatment, abbreviated as SI-R treatment. In the N and R treatments, each seller is randomly matched with a buyer every round. Also, q is randomly drawn every round. It might therefore be difficult for them to reach agreement (equilibrium) quickly. Making information on other sellers' transaction outcomes available to sellers could facilitate transactions between sellers and buyers. Thus, adding these two treatments serves as a robustness check to compare the N treatment and the R treatment, although the effects of social information may be fundamental as discussed in Section 3.3.[6] In the SI treatment, sellers are informed of other sellers' transaction results in their group at the end of each round. The information to be disclosed includes: their offering prices, whether the deals were closed, and the sellers' and their matched buyers' payoffs.[7] Buyers in the SI treatment are not given the opportunity to rate their matched sellers unlike the R treatment, but buyers in the SI-R treatment are given the opportunity to evaluate their matched sellers as in the R treatment. The sellers are asked the same hypothetical question while the rating decisions by the buyers are in progress. Moreover, the sellers in the SI-R treatment are informed of other sellers' transaction results in their own groups. The information to be disclosed includes all the feedback items containing in the SI treatment as well as the rating that each seller received in the current period. Treatment details are summarized in Table 1.

At the end of the experiments, demographic information such as gender and the number of economics courses taken is collected, along with various open-ended questions. These responses are used as control variables in analysis.[8]

[5] This questionnaire is included so that the number of mouse clicks by the sellers is the same as that by the buyers. This is important in order to keep anonymity in the experiment.

[6] It turns out that the difference in subjects' behaviors between the SI and SI-R treatments is similar to that between the N and R treatments (see Section 4).

[7] In each period, each seller is randomly given an identification number from {1, 2, 3, 4, 5}. The identification numbers appear on the computer screen. However, the identification numbers scramble every period so as to exclude reputation effects. In other words, seller 1 on period t computer screen is the same as seller 1 on period t-1 screen with a probability of 20%.

[8] Instructions are available from the authors upon request.

3. Theoretical Predictions and Hypotheses

3.1. Price Setting and Purchase Threshold in the N Treatment

In each period in the experiment, each seller is randomly matched with a buyer and their identification number is also randomly assigned to them. Subjects do not have access to the information on their matched partners' past history of decisions. As discussed in Section 2, the number of interactions is finite and is common knowledge to both buyers and sellers. Therefore, although each buyer (seller) is matched with the same seller (buyer) in the following period with a probability of 20%, the standard theory prediction in the experiment is the same for each stage game. Thus, we devote this section to an analysis of their optimal behavior in each stage game in isolation.

If the randomly drawn value of the object, q_t, was known both to buyers and sellers, then any prices which are greater than or equal to $q_t/2$ can be offered by the sellers under Nash Equilibrium in each stage game, as in the standard ultimatum game with strategy method. When a seller offers a price p that is less than or equal to q_t but greater than or equal to $q_t/2$, and the buyer submits the same p as his or her purchase threshold, then the seller receives a payoff of $p - q_t/2$ and the buyer receives a payoff of $q_t - p$; and there is no incentive for each player to change their strategy. Moreover, a seller offering a price greater than q_t and a buyer setting his or her purchase threshold at a value less than or equal to $q_t/2$ also constitutes a Nash Equilibrium.

In this experiment, however, although the distribution of q_t is common knowledge, the realized value is private information for the sellers. A seller therefore chooses his or her strategy, depending on $q_t \in [0, 40]$, in order to maximize his or her payoff, whereas the matched buyer selects a purchase threshold, p_b, irrespective of q_t as the buyer is not informed of the value of the commodity, so as to maximize his or her expected payoff. As a result, the prediction under the assumption of common knowledge of q_t no longer holds. We write p_{sj}: $[0, 40] \rightarrow [0, 40]$ as the strategy of seller j, and $p_{bi} \in [0, 40]$ as the strategy of buyer i. In Bayesian Nash Equilibrium (BNE), each player best responds to his or her partner. Although we use a discrete interval $\{0, 1, \ldots, 39, 40\}$ in our experiment, for simplicity, we use a continuous interval $[0, 40]$ in our theoretical analysis as the domain of q_t, and we focus on the equilibria in which p_s is strictly increasing in q_t or is constant.

As shown in Appendix A, we find two kinds of Bayesian Nash Equilibria (BNE) from the seller's and the buyer's best response functions. The first kinds of equilibria are the ones in which the buyer obtains an expected payoff of 0 and only the seller obtains a positive payoff. For instance, the following is an equilibrium: the seller proposes $p_s = p_s(q_t) = c$ for $q_t \leq 2c$; and $p_s(q_t) = q_t$ for $q_t > 2c$, and the buyer submits his or her purchase threshold, $p_b = c$. Here, c is any constant that is less than or equal to 20. We see that the expected payoff of the buyer in this example of the equilibria equals $\int_0^{2c}(q_t - c)\cdot\frac{1}{40}dq_t = 0$, whereas the payoff of the seller is calculated by: $c - \frac{1}{2}q_t$ when $q_t \leq$ 2c and 0 when $q_t >$ 2c. The seller's payoff is therefore dependent on q_t, and is positive when $q_t < 2c$.

Although there are multiple BNE of this class, the expected payoff of the seller differs by equilibrium, and is maximized when the following equilibrium is realized: $p_s = p_s(q_t) = 20$ for all q_t, and $p_b = 20$. The expected payoff of the seller is then calculated as:

$$\pi_{sj} = \int_0^{40}\left(20 - \frac{1}{2}q_t\right)\cdot\frac{1}{40}dq_t = 10. \quad (1)$$

This implies that the Pareto dominant (socially optimal) BNE is that the seller, regardless of q_t, proposes to sell the commodity at a price of 20, and the buyer sets the purchase threshold at the price of 20, although then the inequality in payoffs between the seller and the buyer is maximized.

The second class of BNE is the one in which the transaction is not executed. For example, the following is an equilibrium: the seller always posts a price that is greater than or equal to 20, and the buyer sets his or her purchase threshold at 0. In this class of equilibrium, both the seller and the buyer obtain a payoff of 0.

Prediction 1: Standard theory predictions.

There are two different classes of Bayesian Nash Equilibria:

(1) The transaction between a seller and a buyer occurs at prices less than or equal to 20. The buyer obtains an expected payoff of 0, whereas the seller obtains a non-negative payoff. Out of the potential equilibria in our experiment, the Pareto optimal BNE is when the transaction always occurs at a price of 20 and the seller obtains a payoff of 10. This is the seller's payoff dominant equilibrium as well.

(2) The transaction does not occur. In this kind of equilibrium, both the seller and the buyer obtain a payoff of 0. An example is that a seller posts a price that is greater than or equal to 20 for any q, and the buyer sets a purchase threshold at 0.

We can also consider behavioral predictions from a fairness perspective. A rich body of the literature on experiments, including bargaining environments (e.g., ultimatum games and dictator games), has demonstrated that people prefer fair outcomes. If we assume that all of our subjects have inequality-averse preferences and that they know so, then sellers no longer attempt to sell a commodity at prices so that buyers' payoffs are zero, as their inequality-averse buyers would not accept such offers and inequality-averse sellers would also prefer fairer outcomes. Buyer i, when accepting the offer of price p_{sj}, would lose some utility if his or her seller obtains a bigger or smaller payoff than him or herself. In general, the utility function of an inequality-averse buyer can be expressed as:

$$u_{bi}(\pi_{bi}, \pi_{sj}) = \pi_{bi} - \mu_i \cdot f(\pi_{bi} - \pi_{sj}), \tag{2}$$

where μ_i indicates the strength of the inequality-averse preferences relative to her material payoff. In our theoretical analysis, we use the quadratic function as $f(.)$:[9]

$$f(\pi_{bi} - \pi_{sj}) = (\pi_{bi} - \pi_{sj})^2. \tag{3}$$

The utility function of seller j is defined likewise:

$$u_{sj}(\pi_{sj}, \pi_{bi}) = \pi_{sj} - \mu_j \cdot f(\pi_{sj} - \pi_{bi}). \tag{4}$$

Under the hypothesis of the inequality-averse preferences, as shown in Appendix A.2, the seller's best response strategy (price) would depend on the value of object q_t unlike the one with a payoff-maximizing seller, which is to offer a price equal to their matched buyer's purchase threshold as long as it gives himself or herself a positive payoff. The seller's offering price is increasing in q_t when q_t is sufficiently smaller than the seller's belief on the purchase threshold set by his or her

[9] Quadratic functional forms are sometimes used in theoretical analyses of subjects' behaviors. For example, see Cappelen *et al.* (2013). We note that one of the prominent inequality-averse preferences is provided by Fehr and Schmidt (1999). In the Fehr-Schmidt model, buyer i's non-material term is described as: $f(\pi_{bi} - \pi_{sj}) = \alpha_i \cdot max\{\pi_{sj} - \pi_{bi}, 0\} + \beta_i \cdot max\{\pi_{bi} - \pi_{sj}, 0\}$; and the losses are either due to disadvantageous inequality (the first term) or advantageous inequality (the second term). Here, $\alpha_i \geq \beta_i > 0$. The Fehr-Schmidt model becomes similar to Eq. (3) when $\alpha_i = \beta_i$, but it has a kink at $\pi_{bi} = \pi_{sj}$. Our choice of a quadratic function in the analysis is due to its tractability, but would not lose very many important implications because of the choice.

buyer.[10] The slope of the offering price ($\partial p_s/\partial q_t$) is less than 1 when q_t is small because the seller does not want to take everything from the buyer as q_t increases. If a realized q_t is in some range close to the buyer's purchase threshold, the seller attempts to sell the commodity at a price at which the buyer is willing to purchase so that their transaction becomes successful. However, when q_t is large enough that $q_t > q^*$, the seller offers a price strictly greater than the buyer's purchase thresholds in order to prevent their transaction from being closed (see Fig. A.1 in the Appendix). This is intuitive because when q_t is sufficiently large, the buyer would obtain a higher payoff ($q_t - p_s$) than the seller's ($p_s - q_t/2$). The expected acceptance rate of offers in a seller's offering price schedule is $q^*/40$. Notice that sellers are assumed to be heterogeneous (μ_j differs by seller). Therefore, the best response offering price schedule and q^* differ by μ_j. The lower the μ_j is, the higher the q^* is.

In addition to the assumption of inequality-averse preferences of the subjects, we assume that sellers would form their beliefs on the matched buyers' purchase thresholds based on their past interaction outcomes. Moreover, buyers, in addition to sellers, are assumed to have heterogeneous preferences (μ_i also differs by buyer); and they meet each other randomly every period. Dependent on his or her previously encountered purchase thresholds, the seller adjusts the offering price based on his or her best response strategies. Lastly, the quality of the commodity is randomly drawn from [0, 40] every period. Considering these experimental setups and assumptions, we expect that the realized offering prices are increasing in q_t as in the sellers' best response strategies. Also, we expect that the acceptance rate of offers is decreasing in q_t, as the higher the q_t is, the more sellers there are whose best response prices are greater than their matched buyers' purchase thresholds.[11]

Prediction 2: Predictions from inequality-averse preferences.
A seller's offering price (p_s) is increasing in the value of the object, q_t. The slope ($\partial p_s/\partial q_t$) is less than 1 when q_t is small. When q_t is sufficiently large, the offering price (p_s) is greater than the purchase threshold (p_b) and the transaction will not occur. Both the buyer and the seller obtain some positive payoffs in expectation. The acceptance rate of offers is decreasing in q_t.

[10] This offering price schedule is optimal unless the seller's belief about the purchase threshold of her matched buyer is very low. See Appendix A.2 for details.
[11] See Appendix Fig. A.1. q^* in Fig. A.1 differs by seller (μ_j).

Another kind of prominent social preference model is an intention-based social preference model such as a reciprocity model (e.g., Rabin 1993, Charness and Rabin 2002, Dufwenberg and Kirchsteiger 2004, Falk and Fischbacher 2006, Cox *et al.* 2007). In a reciprocity model, agents react hastily or in an unfair manner to hostile or unfair acts toward them by their opponents. In our experiments, buyers have the opportunity to reject unbalanced or unkind offers proposed by their matched sellers by submitting lower purchase thresholds. Thus, this kind of model would also predict a fairer division of the potential gain between the two parties.

3.2. The Effects of Rating Systems in the Experiment in the R treatment

Recent experiments with complete information about pie size have demonstrated that given the opportunity to express their emotion toward sellers, buyers are more likely to accept unfair offers in ultimatum games (e.g., Houser and Xiao 2005, Güth and Levati 2007). The effect of expressing emotion seen on a buyer's attitude can be rationalized by assuming that the buyer's utility weight on inequality, μ_i in Eq. (2), becomes smaller when it is possible to express emotion. If similar effects of expressing emotion are present in our experiment, the expected payoff that a buyer obtains may be smaller in the R treatment than in the N treatment, assuming that the preferences of the sellers are not affected by the buyer's expressing emotion.

Prediction 3: Sellers (buyers) obtain higher (lower) payoffs when buyers are given the opportunity to rate their matched sellers.

How, then, can the seller's decisions be affected by the rating system, while their preferences remain the same? Faced with the decreased μ of buyer i (i.e., μ_i), or, expecting the buyer's more generous acceptance towards an unfair offer, even if his or her preferences are not at all affected, a seller would take advantage of the change in the buyer's openness when q is high enough compared with the buyer's purchase threshold. That is, the seller's offering price would rise for the commodity whose q is such that $q > \frac{4}{3}\hat{p}_{bi} - \frac{1}{6\mu_j}$ but is not sufficiently large, responding to the increase in the buyer's purchase thresholds. Here $\hat{p}_{bi}$ is the equilibrium purchase threshold without the rating system. However, the seller's offering price remains the same for q such that $q <$

$\frac{4}{3}\hat{p}_{bi} - \frac{1}{6\mu_j}$, as shown in Appendix Fig. A.2. This is because the inequality-averse seller's preference for the fair division of their payoffs is not affected by the change in μ of buyer i when q is in this range: if the seller raised her offering price, then the income inequality would rise. Also, the acceptance rate of transactions rises as p_b increases.

However, there are also possibilities that sellers' preferences might also be affected by the prevalence of the rating system; and there are two ways that their strategies can consequently change. On the one hand, the sellers may make more fair offers. Recent research on non-material incentives, such as verbal feedback systems, in dilemmas has proposed that people may have preferences to avoid receiving disapproval from others (e.g., Masclet *et al.* 2003, Dugar 2011, Ellingsen and Johannesson 2008, López-Pérez and Vorsatz 2010, Xian and Houser 2009). The disapproval aversion would make the sellers behave in a fairer way as unfair offers would result in bad ratings from the buyers. Some researchers explain the disapproval aversion by adding another non-material term in the utility function (e.g., López-Pérez and Vorsatz 2010), but we could simply interpret that the disapproval aversion makes the seller's μ (i.e., μ_j in Eq. (4)) larger. On the other hand, the rating system itself may make the sellers more selfish as explained in Section 1. Without the rating system, the sellers may feel obliged to behave in a fair manner on their own. With the rating system, however, instead of feeling obligated to behave fairly to their matched sellers and indeed doing so, the sellers would be simply able to choose to hear the criticism or negative ratings from their matched buyers. In other words, we could conjecture that (a) receiving the criticism and bad ratings from their partners, and (b) behaving nicely to the buyers are substitutes. If the sellers' pro-social attitudes are crowded out by the rating system, the sellers' selfishness is stimulated. We could interpret the second effect as a decrease in μ_j. Therefore, if these two forces are present in our experiment, then whether the sellers behave in a fairer way or more unfair way would depend on which of the two conflicting forces is stronger in the treatment with the rating opportunity.

In ultimatum game experiments under complete information, many studies have demonstrated that sellers offer a very fair division of a pie to their matched buyers. The preference of sellers for a fair or even more fair division of payoffs is also shown in the similar experiments with buyers' rating opportunities under the complete information set-up (e.g., López-Pérez and Vorsatz 2010, Ellingsen and Johannesson 2008, Xiao and Houser 2009). This evidence implies that the former force (i.e., the disapproval aversion) can be stronger under complete information settings. However, one way to predict which way the sellers would be affected in our experiment involves drawing attention to the fact that q_t is only known to the sellers, which is different from these recent experiments. The relative strength of these two forces may depend on the information condition; and the asymmetric information may change the sellers' fairness concerns and maybe the buyers' perception of fairness as well. As discussed in Section 1, some past experiments using ultimatum games have found that sellers offer a significantly smaller amount to their matched buyers when the buyers are not informed of the size of a pie in the games (e.g., Straub and Murnighan 1995, Croson 1996).[12] Taking advantage of the incomplete information on the buyers' side, the sellers strategically attempt to provide greedy offers to their matched buyers, pretending that they have a lower quality of a commodity (e.g., Güth *et al.*, 1996).[13] The experimental setup of incomplete information on the buyers' side may therefore cause the latter force (i.e., stimulated selfishness due to the fairness crowding-out) to be stronger than the former unlike the studies under complete information with rating opportunities. We can then conjecture that a seller makes an attempt to sell the object at a higher price even if the realized value q_t is small, because his or her own payoff is a bigger concern than the matched buyer's. This behavior is rationalized by a decrease in μ_j (see Appendix Fig. A.3).

The impact of the rating system on μ_j can be tested as follows. Suppose that $\bar{p}_b^R$ and $\bar{p}_b^N$ are the average realized purchase threshold in the R treatment and the N treatment, respectively. We denote $\tilde{p}$ as the smaller of $\bar{p}_b^R$ and $\bar{p}_b^N$; and also denote $\tilde{q}$ as the value of the commodity where the average offering price is equal to $\tilde{p}$ in the average realized strategy of the sellers: $p_s = p(q)$ in the corresponding treatment.[14] If seller j's preferences are not affected by the rating system, then, the best responses of seller j are the same in the R and N treatments for each q such that $q \leq \tilde{q}$ (see Appendix Fig. A.2.). Based on these considerations, we can formulate the following hypothesis:

[12] The views on the effects of the incomplete information on sellers' behavior are mixed, however. Other experimental studies in ultimatum games find little difference in the sellers' offering behavior between the incomplete and complete information settings (e.g., Camerer and Loewenstein 1993). Whether our sellers behave in a greedier manner in our environment (i.e., when the sellers have a further opportunity to take advantage of the buyers besides the informational advantage) is therefore an important empirical question.
[13] Also see Gehrig *et al.* (2007).
[14] The seller's realized strategy $p = p(q)$ means the relation between the sellers' offering price and the value of the commodity q in the data of our experiment.

Hypothesis A: The rating system has no effect on μ_j. Therefore, the realized offering prices $p = p(q)$ when $q \leq \tilde{q}$ are not significantly different between the N treatment and the R treatment.

However, if the disapproval aversion is strong as seen in the past similar experiments, that is, if μ_j is higher when the rating system is available, then the best response price of seller j is lower in the R treatment than in the N treatment for each q satisfying $q \leq \tilde{q}$ as shown in Appendix Fig. A.3. Therefore, we have a different hypothesis as below in this case:

Hypothesis B: The rating system raises μ_j. Therefore, the realized offering prices $p = p(q)$ when $q \leq \tilde{q}$ are significantly lower in the R treatment than in the N treatment.

By contrast, if the seller becomes more selfish and μ_j is lower with the rating system available, we have the following hypothesis which is the opposite of Hypothesis B:

Hypothesis C: The rating system lowers μ_j. Therefore, the realized offering prices $p = p(q)$ when $q \leq \tilde{q}$ are significantly higher in the R treatment than in the N treatment.

The acceptance rates are also influenced by the impact of the rating system on μ_j. If μ_j decreases (increases), then the income inequality-averse seller is more (less) willing to sell the object even when q is relatively large. This is because with μ_j decreasing, the seller would not care much about the income inequality anymore; and he or she would want to obtain a positive payoff, even if it is a small profit and the matched buyer obtains a higher payoff than him or her (we would observe the opposite motive when μ_j increases with the rating opportunity). As a result, we expect a higher (lower) acceptance rate of offers in the R treatment than in the N treatment when q is sufficiently high, if the distribution of μ_j shifts to the left (to the right) with the rating opportunities. By contrast, when q is small, seller j attempts to set his price to a level closer to his paired buyer's purchase threshold p_b in order to raise his own payoff as shown in Appendix Fig. A.3. This behavior of seller j raises the possibility of miscoordination between seller j and buyer i. That is, it would decrease the acceptance rate when q is small, unless p_b changes. Therefore, we cannot predict in advance whether the rating system raises or lowers the acceptance rates.

3.3. The Impact of Social Information on Behavior in the SI and SI-R treatments

There are at least two possible impacts that the opportunity to observe other sellers' transaction results may have on the sellers' pricing decisions. First, social information about other pairs' transaction results may facilitate future agreements between the sellers and the buyers because of the sellers' adjustment in pricing. After the sellers learn potential buyers' purchase thresholds, they may adjust their offering prices accordingly considering the expectation of the buyers. It might not be easy for them to coordinate with each other quickly without social information, as each seller is randomly matched with a buyer every round. If the adjustment works effectively, we can expect that the acceptance rate in the SI treatment is higher than in the N treatment and the acceptance rate in the SI-R treatment is higher than in the R treatment. The rest of the predictions for the SI and SI-R treatments remain the same as for the N treatment and the R treatment, respectively.

Prediction 4: Assuming that p_b is the same, the acceptance rate of offers is higher in the SI treatment than in the N treatment and higher in the SI-R treatment than in the R treatment.

Second, the effects of social information might be more fundamental: it might create a competitive atmosphere among the sellers. For example, it is known that given the information of other firms' decisions and payoffs in quantity competition experiments (oligopoly), subjects imitate the strategies of those who achieved the highest payoff; and as a result the market may become more competitive (e.g., Huck *et al* 1999, and Offerman *et al.* 2002). If sellers imitate the strategies of the sellers that achieved higher payoffs in our experiment, then, we would observe that the sellers behave in a more selfish manner both in the SI treatments, as opposed to the N treatment, and in the SI-R treatment, as opposed to the R treatment. Since the lower a seller's μ (i.e., μ_j), the higher payoff the seller obtains given an equilibrium purchase threshold (see Appendix Fig. A.3), this kind of imitation behavior would cause μ_j to decrease and his or her offering price to rise.[15]

[15] We note that imitation of this kind might not occur in our experimental setting, as the sellers have their own matched buyers. In the SI and SI-R treatments, the sellers are informed of the payoffs of the other buyers that are paired with the other four sellers in the current period, in addition to the other sellers' offering prices and payoffs. Learning that

4. Results

Eight sessions, two sessions per treatment, were conducted in a computer room at Brown University from July to October 2013. All participants were Brown undergraduate students.[16] No subjects participated in more than one session for this experiment. Each session contained two groups, which consisted of ten subjects each, and lasted for around one hour. The value of the commodity q_t was randomly selected every period in each session. That is, q_t was the same for the two groups each period.[17] No communication between subjects was permitted during sessions. The experiment was programmed in ztree (Fischbacher 2007). Subjects were paid immediately after the experiment was over. The average earnings were \$15.81 with a standard deviation of \$8.15.

We will first overview the average decisions of the sellers and the buyers in our experiment. Fig. 1(a) and (b) report the average purchase thresholds $\bar{p}_b(q)$ for each realized $q \in \{0, 1, 2, \ldots, 39, 40\}$ and the average offering prices $\bar{p}_s(q)$ for each realized q, respectively. According to Fig. 1(a), $\bar{p}_b(q)$ appears to be unrelated to q, which must have resulted from the fact that the buyers were not informed of the realized q when setting their purchase thresholds. By contrast, $\bar{p}_s(q)$ appears to be increasing in q in all treatments as in Fig. 1(b). These figures also show that in each treatment, when q is small, $\bar{p}_s(q)$ is below $\bar{p}_b(q)$; and that the smaller the q the larger the difference there are between $\bar{p}_s(q)$ and $\bar{p}_b(q)$. However, when q is very large, it seems that $\bar{p}_s(q)$ exceeds $\bar{p}_b(q)$. Moreover, Fig. 1(d) indicates that the average acceptance rate is decreasing in q. These features seen in our results all closely follow Prediction 2 (the predictions from the income inequality-averse preferences). We notice, however, that there is a vast income inequality between the sellers and the buyers: the average payoff of the buyers is much smaller than that of the sellers in each treatment. The ratios of the average buyers' payoffs to the average sellers' payoffs in the N, R, SI and SI-R treatments are .155, .121, .477, and .218, respectively.[18] The average offering prices across all values of q, $\bar{p}_s$, are 18.5, 20.4, 17.2 and 18.6 in the N, R, SI and SI-R treatments, respectively. The average purchase thresholds across all values of q, $\bar{p}_b$, are 18.8, 22.6, 19.0 and

some sellers behave fairly, the sellers could imitate the fair behavior and may behave more generously, although to our knowledge there are no studies that demonstrated such a possibility.

[16] They were recruited by solicitation emails via the BUSSEL (Brown University Social Science Experimental Laboratory). The number of female subjects is 79 (49.4% of the subjects), and the number of subjects with economics concentrations is 26 (16.3% of the subjects).

[17] This feature was employed due to its simplicity.

[18] See Appendix Table B.1.

21.4 in the N, R, SI and SI-R treatments, respectively. These are all close to 20, regardless of treatment conditions.

Here, we encounter one apparent tendency of their transactions in that the income inequality is larger in the treatments with the rating system: there are larger differences in the payoffs between the sellers and the buyers in the R treatment than in the N treatment, and in the SI-R treatment than in the SI treatment. Our data also indicates that the average accepted prices across all values of q are higher in the R and SI-R treatments than in the N and SI treatments. A closer look tells us that $\bar{p}_s(q)$ and $\bar{p}_b(q)$ are both higher for most values of q in the R treatment than in the N treatment; and in the SI-R treatment than in the SI treatment [Fig. 1(a) and (b)]. The higher purchase thresholds set by the buyers with the rating system available are consistent with the findings in the recent related papers on the effects of expressing emotion under complete information: expressing emotion may make buyers accept more unfair offers as the emission of emotion can be a substitute for rejecting the offers (e.g., Xiao and Houser 2005). However, intriguingly, the higher offering prices set by the sellers in the R and SI-R treatments are contrary to these earlier studies. Especially, the smaller the q, the larger the difference in $\bar{p}_s(q)$ between the R (SI-R) treatment and the N (SI) treatment, which appears to resonate with Hypothesis C that we formulated in Section 3.2. Moreover, we find that the average acceptance rate in the R (SI-R) treatment is 64.0% (69.4%), which is higher than that in the N (SI) treatment, 60.6% (59.0%).

To formally examine the determinants of the buyers' decisions by treatment, we conduct a regression analysis in which the dependent variable is their purchase threshold. In order to measure the effects of each treatment condition on their behavior, "other deal info" dummy (which equals 1 in the SI or SI-R treatment; 0 otherwise), "rating" dummy (which equals 1 in the R or SI-R treatment; 0 otherwise), and "other rating info" dummy (which equals 1 in the SI-R treatment; 0 otherwise) are included as independent variables. We also include a period variable $\{= 2, 3, \ldots, 50\}$ to control the time trend, and we include "deal closed" dummy in period $t - 1$ (which equals 1 if $p_{bi} \geq p_{sj}$ in period $t - 1$; 0 otherwise) since the buyers' decisions in a particular period may be affected by the transaction outcome of the period immediately before it. Moreover, the value of the commodity in the preceding period is also added as a control since q in the preceding period may be serving as a reference point for the buyers.[19] Our regression results indicate a clear pattern and confirm our observation mentioned above. As shown in Panel (A) of Table 2, the rating dummy obtains a significantly positive coefficient, regardless of whether the demographic data is controlled for. This suggests that the buyers are significantly more open to unfair offers with the rating systems available to them. This result implies that the recent findings also apply for a setting with incomplete information on the buyers' side.

We also find that the buyers' decisions are not significantly affected by the social information provided to the sellers; neither the other deal info nor other rating info dummy obtains a significant coefficient.

The deal closed dummy in period $t - 1$ obtains a significantly positive coefficient. This shows that the buyers whose deals were closed in period $t - 1$ set higher purchase thresholds in period t than the buyers whose deal were not closed in period $t - 1$. Note that the buyers whose deals were close are the buyers that submitted a higher purchase threshold, holding all other factors constant. This implies that the buyers that set higher purchase thresholds in period $t - 1$ continued to set higher purchase thresholds in period t, compared with those who set lower purchase thresholds.

Result 1: The buyers set significantly higher purchase thresholds when they are given the opportunity to rate their matched sellers. The buyers' decisions are not affected by whether the sellers hold information on other transaction outcomes.

Panel (B) of Table 2 reports the determinants of the sellers' offering prices. In the regressions, the value of the commodity in period t, q_t, is added as an independent variable because the sellers were informed of the realized q_t when making offers unlike the buyers. The regression results confirm our observations above related to Fig. 1. First, q_t obtains a significantly positive coefficient, and the coefficient is strictly less than 1.[20] Second, the constant term is significantly positive. Third, since the average purchase threshold $\bar{p}_b$ is around 20 in each treatment, when q_t is

[19] We note that besides this reason it would be necessary to control for q_{t-1} as the value of the commodity was slightly higher in the R treatment than in the other three treatments (see Appendix Table B.1). Responding to the addition of q_{t-1}, the own payoff in period $t - 1$ variable is not included as an independent variable in Panel (A) so as to avoid a multicollinearity problem: the interaction term q_{t-1} and the deal closed dummy in period $t - 1$ are instead included in this Panel.

[20] Two-sided t tests find that the coefficients for q_t are significantly less than 1 in columns (5) and (6).

sufficiently large, the average offering price $\bar{p}_s(q)$ is greater than $\bar{p}_b(q)$ in all of the four treatments.[21] This implies that if q was sufficiently large, their deals were less likely to be closed. These results are all consistent with Prediction 2. This also suggests that the ratio of the sellers' average demanded payoff to realized q_t is decreasing in q_t.[22] This is consistent with Mitzkewitz and Nagel (1993) and Rapoport *et al.* (1996) that find that the fraction of the proposer's share is decreasing in the realized size of pie in ultimatum games with incomplete information where the responders accept or reject the share their matched proposers demand.[23]

Result 2: The following holds in all treatments: (1) The sellers' average offering prices are increasing in the value of the commodity, q_t. (2) $\partial\bar{p}_s(q_t)/\partial q_t$ is significantly greater than 0, but is significantly less than 1. (3) When q_t is sufficiently large (small), $\bar{p}_s$ is larger (smaller) than $\bar{p}_b$.

Table 2 (B) also shows that $\partial\bar{p}_s(q_t)/\partial q_t$ is significantly smaller in the R (SI-R) treatment than in the N (SI) treatment. This may suggest that μ_j decreases with the rating systems available, as the smaller the μ_j the smaller the slope tends to be.[24] Moreover, we find that the rating dummy variable obtains a significantly positive coefficient. This suggests that the sellers tend to exploit their matched buyers more when the rating system is available. As discussed in Section 3.2, the significantly positive coefficient for the rating dummy may have stemmed from two factors. The first possible factor is the rational response of the sellers to the increase in their buyers' purchase thresholds. The second possible factor is the effects of selfishness stimulated by the fairness crowding-out caused by the rating system (i.e., a decrease in μ_j) as discussed in Hypothesis C in the subsection. We conduct a regression analysis restricting data as outlined in Section 3.2 so as to

[21] This holds true regardless of which estimates in Table 2(B) we assume. In our data, $\bar{p}_b$= 18.758, 18.976, 22.553, and 21.347 in the N, SI, R and SI-R treatments, respectively (Appendix Table B.1). Suppose that the marginal effects of each independent variable on the expected value of the latent dependent variable $\bar{p}_s{}^*(q)$ are as in column (6) of Panel (B), for an illustration. Then, $\bar{p}_s{}^*(q) = c_N + 11.840 + .308\cdot q$, $\bar{p}_s{}^*(q) = c_{SI} + 11.840 - 1.051 + .308\cdot q$, $\bar{p}_s{}^*(q) = c_R + 11.840 + 1.213 + .308\cdot q$ and $\bar{p}_s{}^*(q) = c_{SI\text{-}R} + 11.840 - 1.051 + 1.213 - .078 + .308\cdot q$ in the N, SI, R and SI-R treatments, respectively. Here, c_N, c_{SI}, c_R, and $c_{SI\text{-}R}$ are the average effects of all independent variables except variables (a) to (d) and the constant terms in each treatment, and are calculated as follows: $c_N = .379$, $c_{SI} = .298$, $c_R = .429$, and $c_{SI\text{-}R} = .480$. Thus, the conditions of q so that $\bar{p}_s{}^*(q) < \bar{p}_b$ are approximately calculated as $q < 21.231$, $q < 25.614$, $q < 29.451$ and $q < 29.036$ in the N, SI, R and SI-R treatments, respectively.

[22] Appendix Table B.7 shows that the ratio of the buyers' payoff to realized q_t is increasing in q_t, which also supports this result.

[23] In these studies, unlike our paper, the proposers had to split a realized pie so that both the proposers and the responders received non-negative payoffs.

[24] See Appendix Fig. A.3. For a given p_{bi}, the smaller μ_j, the higher q^* and the smaller the term $\frac{4}{3}p_{bi} - \frac{1}{6\mu_j}$.

test the significance of the second possible factor. Specifically, we test which Hypothesis (A, B or C) holds in our data. Since the average purchase threshold $\bar{p}_b$ is the lowest in the N treatment among the four treatments (${\bar{p}_b}^N$=18.76), we use the N treatment in order to restrict the set of q. The sellers' average offering price $\bar{p}_s(q)$ in the N treatment is largely increasing in q as shown in Fig. 1(b), but is not monotonically increasing (see Panel (A) of Appendix Table B.2). Thus, it is difficult to find a precise q such that $\bar{p}_s(q) = 18.76$ in the N treatment. We therefore use several subsets of q: $q \leq 20$, $q \leq 20$, …, and $q \leq 25$, as the condition of q satisfying $\bar{p}_s(q) < {\bar{p}_b}^N$.[25] Results are similar regardless of which subset we use: the rating dummy variable obtains a significantly positive coefficient at the 10% level (see Panel (B) of Appendix Table B.2).[26, 27] This implies that the sellers' average offering price is significantly higher at the 10% level with the rating opportunities when q is in these ranges. In other words, our data supports Hypothesis C. We therefore conclude that the rating system given to the buyers triggers the sellers' selfishness (the distribution of μ_j shifts downward) and causes the sellers to offer higher prices to their buyers even when q is not large in our experiment.

Result 3: Hypothesis C holds. The sellers offer significantly higher prices to their matched buyers when the buyers are given the opportunity to rate their matched sellers and when q is in the range described in Hypothesis C.

We note that the sellers' tendency may be affected by the presence of the social information on other deals provided to them as well, unlike with the buyers. Table 2 (B) indicates that the other deal info dummy obtains a significantly negative coefficient at the 10% level as shown in column (6), although not in column (5); which suggests that the information on the other sellers' transaction outcomes may not create a competitive atmosphere in ultimatums. The negative coefficient implies that the sellers may instead act in a fairer manner with the social information. This may result from the setup in which sellers are aware of the payoffs of the other buyers that are

[25] Recall that in these ranges of q, the sellers' offering prices must not significantly change with the rating system available unless their preferences are affected.

[26] The coefficient estimates of the rating dummies are larger in Appendix Table B.2. than in Table 2. However, the significance levels of them decrease. This is simply because the number of observations used in Table B.2 is around the half of those in Table 2.

[27] If we estimate the same models using only the data of the N and R treatments (the SI and SI-R treatments), we find that the rating dummy obtains a significantly positive coefficient at the 10% level (at the 1% level), regardless of which subset we use. The detailed results are omitted to conserve space.

paired with the other four sellers. Appendix Table B.2 (B), however, shows that these effects are on average insignificant as shown in columns (i), (ii), (iii), (iv) and (v). Although there is no clear-cut evidence on such behavioral effects, studying the impact of the information concerning buyers' welfare on the sellers' behavior would be an interesting area for future research.

In order to check whether the significantly higher offering prices and purchase thresholds seen with the rating system are due to the presence of level effects, we conduct an additional regression analysis whose dependent variable is either the change in the buyers' purchase threshold or that in the sellers' offering price between consecutive periods, and whose independent variables include the rating dummy, the other deal info dummy and the other rating info dummy. As shown in Appendix Table B.3, we find that the rating dummy variable no longer obtains a significant coefficient. This suggests that the higher offering prices and purchase thresholds in the R and SI-R treatments did not result from the sellers' or buyers' temporal adjustments of decisions through their changes in expectation of their counterparts' decisions, but were in fact level effects.

The general tendency throughout the four treatments is that the buyers adjusted their purchase thresholds based on their matched sellers' offering prices in the preceding period. The buyers that purchased commodities (i.e., those whose p_b was greater than or equal to p_s) significantly decrease their purchase thresholds in the following period, whereas those who did not purchase the commodity (i.e., those whose p_b was lower than p_s) significantly increase them.[28] The difference in the change of p_b between the former and the latter buyers is significant as shown in a significantly negative coefficient of the deal closed dummy (see variable (a3) in Panel (A) of Table 3). In the treatments with the rating system, the decisions of the buyers are affected by their expression of emotion in the preceding period to some degree, however. The more unfair the transactions are or the less payoffs the buyers received, the more likely the buyers were to give social disapproval to their matched sellers.[29] Furthermore, the more disapproval points they assigned to their matched sellers, the more likely they were to decrease their purchase thresholds in the following period (see variable (a6) in Panel (A) of Table 3).

[28] When their deals were closed, the total average difference between p_b and p_s was 6.86 points over the four treatments; and the buyers decreased their purchase thresholds by 1.68 points on average in the following period. When their deals were not closed, the total average difference between p_b and p_s was 7.07 points over the four treatments; and the buyers increased their purchase thresholds by 3.08 points on average in the following period. One-sample t tests (two-sided) find that the decrease of 1.68 points and the increase of 3.08 points are each statistically significant at the 1% level. Results are similar when they are calculated by treatment.

[29] See Appendix Table B.5(I).

The decisions of the sellers are also affected by the rating they received in the preceding period to some degree. When sellers are not successful in closing the transaction, the fairer prices the sellers offer for a realized q or the higher payoffs the buyers otherwise obtained if their deals were closed, the more likely the buyers are to give social approval to their matched sellers.[30] Further, the more positive rating the sellers receive from their matched buyers, the more likely they are to raise their offering prices in the next round (variable (b10) in Panel (B) of Table 3). The decisions of the sellers are additionally influenced by some social information. When information on other deals is available to a seller, regardless of whether her offering price is accepted or rejected by the matched buyer, the seller is more likely to decrease (increase) her offering price in the following period if she learns that her group's average accepted price was below (above) her own offering price (see variables (b4) to (b7) of the table). As for the impact of the information about other sellers' rating scores, we find that it does not affect the sellers' decisions. As a final remark about the dynamics of their decisions, we find that the sellers that sold the commodity (i.e., those whose p_b was greater than or equal to p_s) increase their offering prices in the following period, whereas those who were unable to sell the commodity on average decrease them.[31] The difference in the change of p_s between the former and the latter sellers is significant, as seen in a significantly positive coefficient of the deal closed dummy in Panel (B).[32]

Result 4: When the deals are closed (i.e., $p_b \geq p_s$), the buyers decrease their purchase thresholds and the sellers increase their offering prices in the following period. When they are not closed (i.e., $p_b < p_s$), the buyers increase their purchase thresholds and the sellers decrease their offering prices in the following period.

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[30] See Appendix Table B.5(II).

[31] See footnote 28. When their deals were closed, the sellers increased their offering prices by 1.84 points on average in the following period. When their deals were not closed, the sellers decreased their offering prices by 2.92 points on average in the following period. One-sample t tests (two-sided) find that the increase of 1.84 points and the decrease of 2.92 points are each statistically significant at the 1% level. Results are similar when they are calculated by treatment.

[32] In the R or SI-R treatments, the sellers were asked the prices that they would have offered if they had had a second chance to sell the commodity whose value was the same as q in the current period. A regression analysis confirms that the deal closed dummy in period t is a positive predictor for the amount of the hypothetical prices minus their already submitted actual prices in period t. This result is consistent with that in Panel (B). The detailed results are omitted to conserve space.

Result 5: When information on other deals is available to the sellers, the sellers adjust their offering prices toward their group's average accepted price. The information about rating scores that other sellers received do not affect the seller's decisions in the following period.

The acceptance rates of transactions are theoretically related to the realized purchase thresholds and μ_j as discussed in Section 3. To examine the relation formally using our data, we conduct a regression analysis whose dependent variable is a dummy variable that equals 1 if a deal between buyer i and seller j is closed and 0 otherwise, as shown in Appendix Table B.6. First, the analysis confirms our observations in Fig. 1(d): the acceptance rate is decreasing significantly in the value of the commodity (q_t). This supports the prediction based on the income inequality-averse preferences (Prediction 2). Second, as shown in columns (1) and (2) of Table B.6, the acceptance rate is significantly higher with the rating opportunities. Fig. 1(d) especially reveals the higher acceptance rates in the R and SI-R treatments for higher values of q. Two possible causes behind the higher acceptance rates of the two treatments are: (i) higher realized purchase thresholds in these treatments; and (ii) more frequent acceptances for higher value of q stemming from a decrease in μ_j. By using buyers' purchase thresholds (p_b), instead of q, as an independent variable as shown in columns (5) to (8), we find that the higher acceptance rates in the R and SI-R treatments result from higher p_b. p_b is a significantly positive predictor of the acceptance rate; and once p_b is controlled for as an independent variable, the rating dummy variable obtains a negative coefficient. This resonates with the idea that the rating system makes the sellers act more selfishly, and makes them attempt to raise their offering prices close to their paired buyers' expected purchase thresholds, raising the possibility of their transaction ending in failure.[33]

Result 6: The higher the q, the lower the acceptance rate of an offer. The higher the p_b, the higher the acceptance rate. The acceptance rate is higher when the rating opportunity is available, which results from higher purchase thresholds set by the buyers in the R and SI-R treatments.

Finally, to examine the consequences of having the rating system on the income inequality between the buyers and the sellers, we conduct a regression analysis in which the dependent

[33] We note that information on other deals provided to the sellers had little effect on the acceptance rates of offers in the SI and SI-R treatments. As shown in columns (1), (2), (5) and (6) of Appendix Table B.6, the other deal info dummy fails to obtain a significant coefficient.

variable is the ratio of the buyer's payoff to q, and independent variables include the rating dummy along with other variables. The results, found in Appendix Table B.7, confirm our earlier observation in Fig. 1 and Table B.1: the ratio of payoff that the buyers obtain to realized q is significantly smaller at the 10% level when the rating systems are available to them. One reason that this result is only significant at the 10% level is presumably that the number of groups is four in each treatment. This is, however, suggestive of a more adverse effect of the rating system under incomplete information and is consistent with other results that we have provided in this paper.

5. Conclusions

This paper experimentally investigates the effects of expressing emotion when only the sellers are informed in advance of the values of commodities in an ultimatum game. We find that the buyers become more accepting of potentially unfair offers when a rating system is available to them. This suggests that recent findings on the impact of expressing emotion in a complete information environment may extend to a setting with incomplete information. However, we find that the sellers behave in a greedier manner when the rating system is present, unlike the results of previous studies under setups with complete information. We can interpret part of this result to mean that receiving criticism and bad ratings can be treated by sellers as a substitute for feeling obligated to behave in a fair manner and actually dealing fairly. In our model, this could be interpreted as a decrease in sellers' μ when the rating system is present.

Besides previous studies on disapproval aversion, our study is also related to the growing body of research on online reputation mechanisms. On a variety of emerging online services such as eBay.com and Amazon.com, users have opportunities to rate their sellers subsequent to the completion of transactions, and the ratings are open to the public. Recent experimental studies using repeated game environments have documented that such feedback opportunities may promote people's non-selfish behavior, for example trust and trustworthiness between two parties (e.g., Keser 2002, Bolton *et al.* 2004), thanks to reputation effects, indirect reciprocity, and perhaps social disapproval aversion. Specifically, by using ultimatum games, theoretical, although not experimental, research has demonstrated that fairness may evolve if sellers are informed of their matched buyer's past decisions (e.g., Nowak *et al.* 2000) or if players are allowed to choose their partners based on the outcomes of past interactions (e.g., Chiang 2008) under complete information settings, because of the reputation effects. Our data indicates that the effects of the rating system, or emotional expression alone, may be more adverse with incomplete information, relative to settings with complete information. This result seems to suggest that other factors such as the reputation effects and indirect reciprocity may be crucial for fairness to evolve especially in settings with incomplete information when the ratings are disclosed to the sellers. It would be interesting to study how fairness evolves under incomplete information settings when sellers have access to information on buyers' past decisions.

Although our first evidence showing that a rating opportunity can have a more adverse effect on the individuals doing the rating under asymmetric information is clear, there are many areas for future research. First, details of the experimental setups might affect the direction or degree of the effects of expressing emotion. For instance, in our design, unlike other standard ultimatum games with incomplete information, the payoffs of the buyers were negative if $p_s > q$. This setup of ours is reasonable as it is more realistic for some circumstances, but it would also be a useful follow-up study to examine the effects of expressing emotion in a setup where the seller has to split the pie so that both she and her matched buyer obtain positive payoffs. Also, the framing used in experiments may affect the significance of the effects of emotional expression as people's behavior is known to be sensitive to how experiments are framed.[34] Second, it would be crucial to perform a robustness check to study the effects of expressing emotion in incomplete information settings using different games such as dictator games, prisoner's dilemma games, and voluntary contribution games in order to establish the behavioral regularity of our hypothesis and to explore the conditions under which the impact of the rating system may be adverse. It is possible that the disapproval-averse motive is stronger than the fairness crowding-out effect in other game structures. Third, it would be interesting to study the effects of expressing emotion in a setup where the information is even more asymmetric. In our experiment, the buyers were informed of the true value of q at the end of each period. In some real world situations, however, buyers may lack the information even after their purchases. It may take months or years for the buyers to fully evaluate quality. In that case, buyers may not be aware of quality when they give their ratings. Fourth, once we build a solid observational foundation on the behavioral regularity for the fairness crowding-out along with the disapproval aversion, the next important step would

[34] For example, Mitzkewitz and Nagel (1993) find that subjects' behavior can be significantly different between offer games and demand games when playing ultimatum games with incomplete information on the buyers' sides.

be to explore these phenomena more theoretically. Fifth, needless to say, replication studies and field experiments would be essential as results may depend on various factors such as culture, nations and subjects' populations.

Lastly, if our results are robust, then, they also have an implication for some firms' decision-making. If customers are more likely to accept bad deals when they have options to express their emotion to their sellers, and if the firms care about their payoffs more than their customers, then, they might strategically introduce feedback opportunities that are not open to the public; simply listening to their criticism may be easier than making efforts to satisfy the customers and it may also mitigate the negative feeling that they incur from exploiting their customers.

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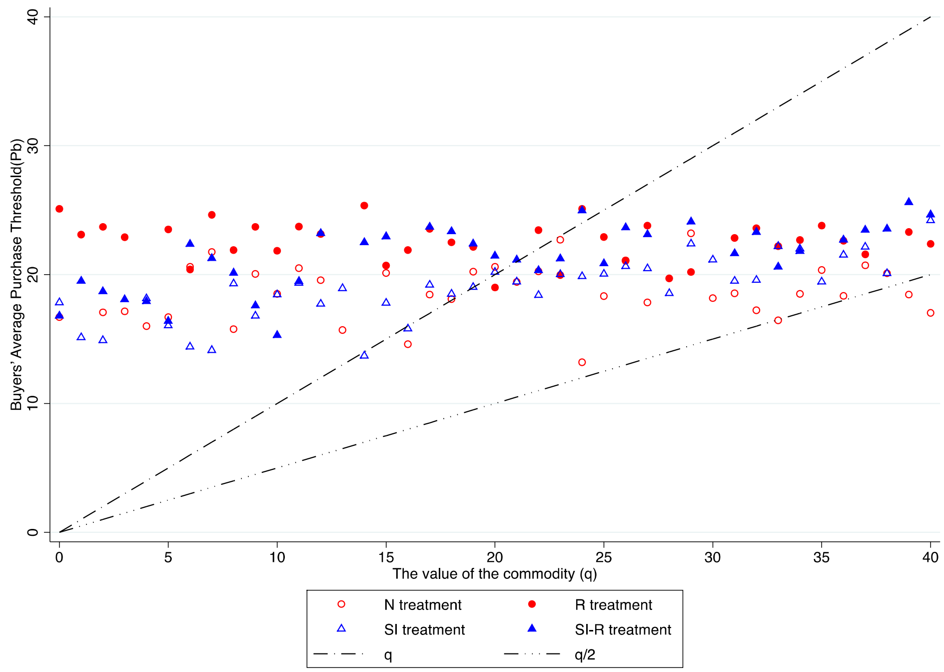
Table 1: Summary of Treatments

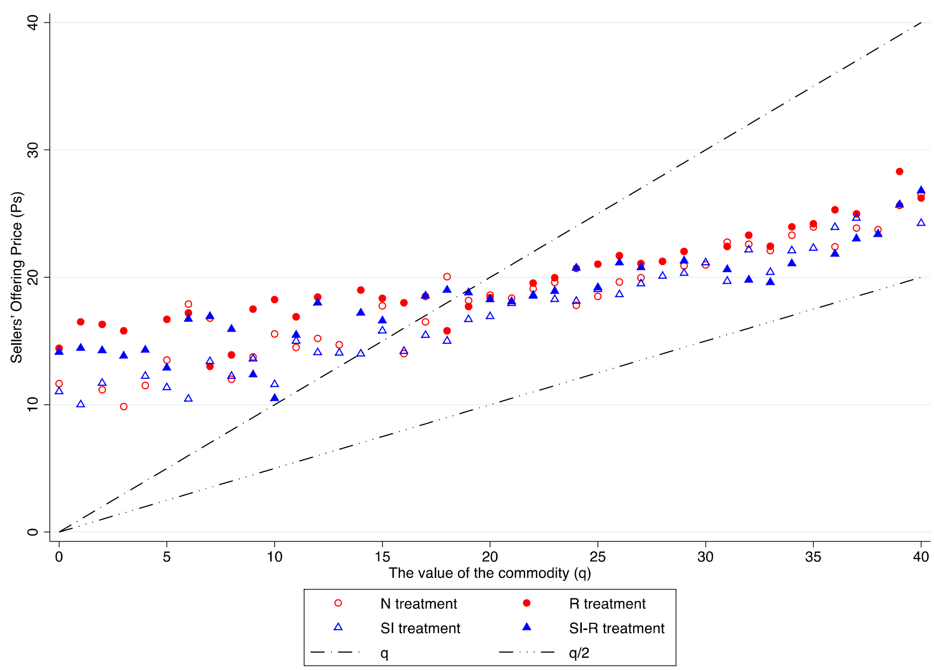
Treatment	Rating process	Social information available to sellers	Number of groups	Number of subjects
N	No	No	4	40
SI	No	• The offering prices by other sellers • Whether other deals are closed • The payoffs of other sellers • The payoffs of other buyers	4	40
R	Yes	No	4	40
SI-R	Yes	• The offering prices of other sellers • whether other deals were closed • The payoffs of other sellers • The payoffs of other buyers • Ratings of other sellers	4	40

Fig. 1: The Sellers' Average Offering Prices and the Buyers' Average Purchase Thresholds by the Value of the Commodity

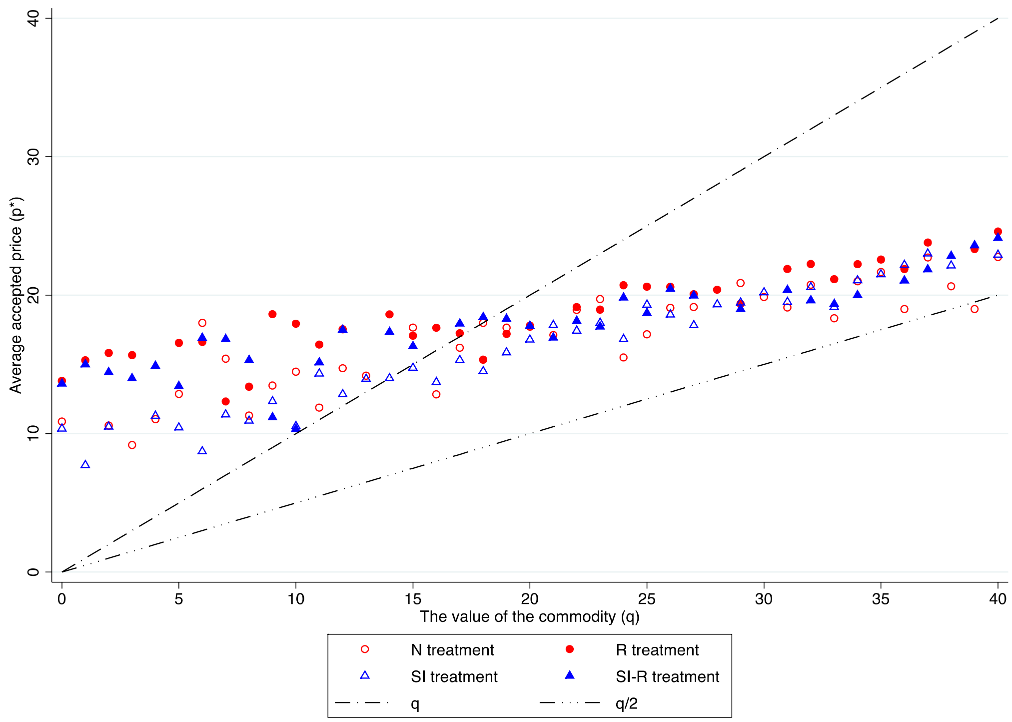
(a) The buyers' average purchase thresholds:



(b) The sellers' average offering prices:



(c) The acceptance prices:



(d) The average acceptance rate:

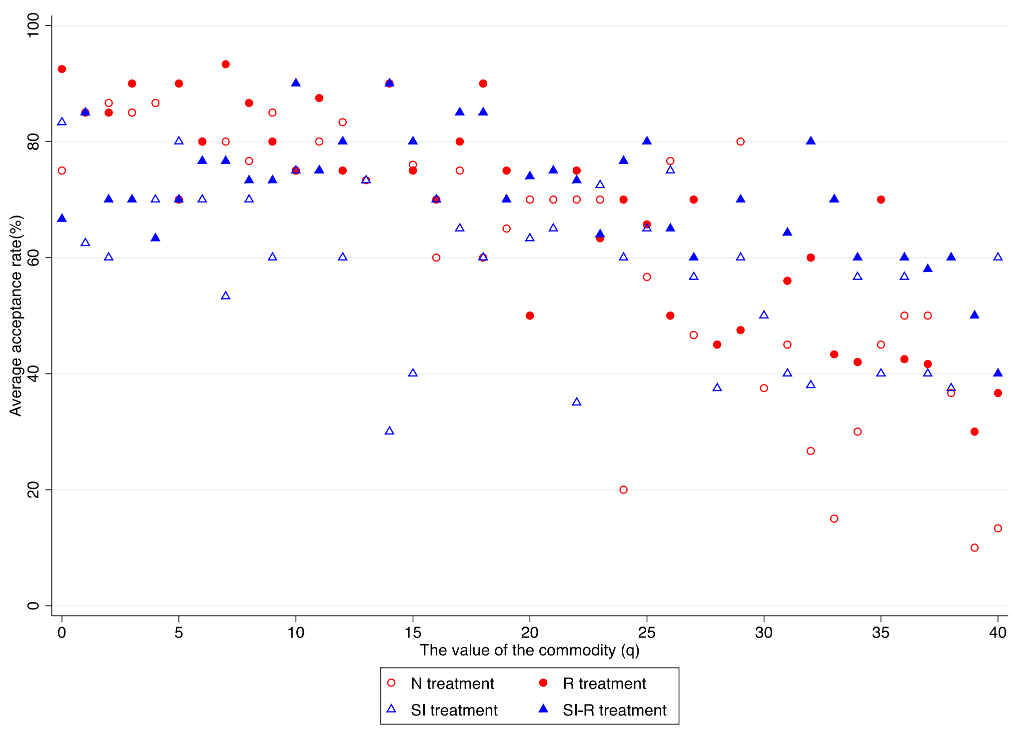


Table 2: The Determinants of the Buyers' Purchase Thresholds and the Sellers' Offering Prices

(A) Dependent variable: Buyer i's purchase threshold in period t (p_{bi}^{t})

Independent variables	(1)	(2)	(3)	(4)
(a) Value of the commodity in period $t-1$ (q_{t-1}) {= 0, 1, …, 39, 40}	0.029* (0.015)	0.030* (0.015)	0.036* (0.022)	0.036* (0.022)
(b) Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	0.80 (1.94)	0.90 (1.94)	0.87 (2.00)	0.97 (2.01)
(c) Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	3.84** (1.93)	3.83** (1.94)	3.98** (2.01)	3.96** (2.01)
(d) Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	-1.77 (2.74)	-1.99 (2.77)	-1.65 (2.83)	-1.88 (2.86)
(e) Deal closed dummy in period $t-1$ {= 1 if $p_{bi}^{t-1} \geq p_{sj}^{t-1}$; 0 otherwise}	1.10** (0.50)	1.10** (0.50)	1.09** (0.50)	1.10** (0.50)
Interaction Terms				
(a) × (b)	----	----	-0.0034 (0.025)	-0.0033 (0.025)
(a) × (c)	----	----	-0.0065 (0.025)	-0.0065 (0.025)
(a) × (d)	----	----	-0.0059 (0.0351)	-0.0060 (0.035)
(a) × (e)	0.038* (0.0197)	0.038* (0.0197)	0.039** (0.020)	0.039** (0.020)
Period = {2, 3, …, 50}	0.023*** (0.0073)	0.023*** (0.0073)	0.022*** (0.007)	0.022*** (0.0073)
Control Variables	No	Yes[1]	No	Yes[1]
Constant	16.6*** (1.44)	16.1*** (2.99)	16.4*** (1.48)	16.0*** (3.01)
Observations	3,920	3,920	3,920	3,920
Log Likelihood	-12376	-12375	-12376	-12375
Wald chi^2	103.9	106.4	104.4	106.9
Prob > chi^2	0.000	0.000	0.000	0.000

Notes: Random-effects Tobit regressions. Numbers in parenthesis are standard errors. The numbers of left-(right-) censored observations are 24(220) in columns (1), (2), (3) and (4). Results are similar when random-effects linear regressions with robust standard errors clustered by group ID are used.

[1] Control variables include the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family. None of them obtains a significant coefficient. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.

*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

(B) Dependent variable: Seller j's offering price in period t (p_{sj}^{t})

Independent variables	(5)	(6)	(7)	(8)
(a) Value of the commodity in period t (q_t) {= 0, 1, …, 39, 40}	0.31*** (0.0053)	0.31** (0.0053)	0.34*** (0.011)	0.34*** (0.011)
(b) Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	-0.99 (0.61)	-1.05* (0.60)	-1.52** (0.68)	-1.57** (0.68)
(c) Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	1.23** (0.61)	1.21** (0.61)	2.26*** (0.69)	2.25*** (0.69)
(d) Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	-0.076 (0.86)	-0.078 (0.88)	1.09 (0.96)	1.09 (0.96)
Interaction Terms				
(a) × (b)	----	----	0.027* (0.015)	0.027* (0.015)
(a) × (c)	----	----	-0.047*** (0.015)	-0.048*** (0.015)
(a) × (d)	----	----	-0.060*** (0.021)	-0.060*** (0.021)
Own payoff in period $t-1$	0.080*** (0.018)	0.080*** (0.018)	0.082*** (0.017)	0.082*** (0.018)
Deal closed dummy in period $t-1$ {= 1 if $p_{bi}^{t-1} \geq p_{sj}^{t-1}$; 0 otherwise}	0.034 (0.19)	0.037 (0.19)	0.0089 (0.19)	0.012 (0.19)
Period = {2, 3, …, 50}	0.016*** (0.0044)	0.016*** (0.0044)	0.014*** (0.0044)	0.014*** (0.0044)
Control Variables	No	Yes[1]	No	Yes[1]
Constant	11.3*** (0.46)	11.8*** (1.07)	10.8*** (0.50)	11.3*** (1.08)
Observations	3,920	3,920	3,920	3,920
Log Likelihood	-10940	-10939	-10908	-10907
Wald chi^2	3528.0	3531.6	3649.4	3653.2
Prob > chi^2	0.000	0.000	0.000	0.000

Notes: Random-effects Tobit regressions. Numbers in parenthesis are standard errors. The numbers of left-(right-) censored observations are 9(21) in columns (5), (6), (7) and (8). Results are similar when random-effects linear regressions with robust standard errors clustered by group ID are used.

[1] Control variables include the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family. None of them obtains a significant coefficient. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.

*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

Table 3: The Dynamics of the Strategies Chosen by the Sellers and the Buyers

(A) Dependent variable: $p_{bi}^{t} - p_{bi}^{t-1}$

	Treatment			
	N	SI	R	SI-R
Independent variables	(1)	(2)	(3)	(4)
(a1) Change in the value of the commodity in period $t-1$ ($q_{t-1} - q_{t-2}$)	-0.0094 (0.012)	0.044 (0.037)	0.0012 (0.0077)	0.00048 (0.013)
(a2) Value of the commodity in period $t-1$ (q_{t-1}) {= 0, 1, …, 39, 40}	-0.073 (0.040)	-0.24 (0.13)	-0.069 (0.052)	0.30*** (0.038)
(a3) Deal closed dummy in period $t-1$ {= 1 if $p_{bi}^{t-1} \geq p_{sj}^{t-1}$; 0 otherwise}	-5.56*** (0.94)	-7.86** (2.38)	-3.84 (1.98)	-9.83** (1.95)
(a4) Value of the commodity in period $t-1$ (q_{t-1}) × Deal closed dummy in period $t-1$ {= 1 if $p_{bi}^{t-1} \geq p_{sj}^{t-1}$; 0 otherwise}	0.072 (0.031)	0.052 (0.086)	-0.0019 (0.046)	0.15** (0.028)
(a5) (Own rating − 5) × Social approval dummy × Deal closed dummy in period $t-1$	---	---	0.0023 (0.047)	0.094 (0.16)
(a6) (5 − Own rating) × Social disapproval dummy × Deal closed dummy in period $t-1$	---	---	-0.56* (0.21)	-0.44* (0.16)
(a7) (Own rating − 5) × Social approval dummy × (1 − Deal closed dummy in period $t-1$)	---	---	0.44* (0.16)	1.23 (0.90)
(a8) (5 − Own rating) × Social disapproval dummy × (1 − Deal closed dummy in period $t-1$)	---	---	0.31 (0.62)	0.31 (0.75)
Period = {3, 4, …, 50}	0.0086 (0.0083)	0.023 (0.013)	0.0032 (0.0100)	0.0028 (0.0077)
Constant	4.03** (0.99)	8.40* (2.98)	4.19 (2.21)	10.53*** (1.71)
Observations	960	960	960	960
R-squared	0.125	0.190	0.157	0.285

Notes: Fixed effects linear regressions with robust standard errors clustered by group ID. The social approval (disapproval) dummy equals 1 if buyer i's rating to his or her matched seller is greater than or equal to (less than) 5; 0 otherwise.*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

(B) Dependent variable: $p_{sj}^{t} - p_{sj}^{t-1}$

Independent variables	Treatment N (1)	SI (2)	R (3)	SI-R (4)
(b1) Change in the value of the commodity in period $t-1$ ($q_{\text{t}} - q_{\text{t}-1}$)	0.34*** (0.044)	0.379*** (0.035)	0.32*** (0.038)	0.27*** (0.028)
(b2) Deal closed dummy in period $t-1$ {= 1 if $p_{bi}^{t-1} \geq p_{sj}^{t-1}$; 0 otherwise}	7.77*** (1.024)	5.36*** (0.61)	10.29*** (0.82)	6.03*** (1.01)
(b3) Own payoff in period $t-1$	-0.61*** (0.079)	-0.76*** (0.077)	-0.65*** (0.051)	-0.49** (0.13)
(b4) (p_{sj}^{t-1} – average group accepted price in period $t-1$) × $1_{\{\text{average group accepted price in period } t-1 \leq p_{sj}^{t-1}\}}$ × Deal closed dummy in period $t-1$	---	-0.067 (0.075)	---	-0.68** (0.15)
(b5) (Average group accepted price in period $t-1$ – p_{sj}^{t-1}) × $1_{\{\text{average group accepted price in period } t-1 > p_{sj}^{t-1}\}}$ × Deal closed dummy in period $t-1$	---	0.37** (0.10)	---	0.41 (0.25)
(b6) (p_{sj}^{t-1} – average group accepted price in period $t-1$) × $1_{\{\text{average group accepted price in period } t-1 \leq p_{sj}^{t-1}\}}$× (1 − Deal closed dummy in period $t-1$)	---	-0.84*** (0.056)	---	-0.63*** (0.074)
(b7) (Average group accepted price in period $t-1$ – p_{sj}^{t-1}) × $1_{\{\text{average group accepted price in period } t-1 > p_{sj}^{t-1}\}}$× (1 − Deal closed dummy in period $t-1$)	---	0.25 (0.11)	---	0.60** (0.14)
(b8) (Own rating − 5) × Social approval dummy × Deal closed dummy in period $t-1$	---	---	-0.32* (0.11)	-0.16 (0.083)
(b9) (5 − Own rating) × Social disapproval dummy × Deal closed dummy in period $t-1$	---	---	-0.043 (0.12)	-0.026 (0.096)
(b10) (Own rating − 5) × Social approval dummy × (1 − Deal closed dummy in period $t-1$)	---	---	0.61*** (0.063)	0.44*** (0.072)
(b11) (5 − Own rating) × Social disapproval dummy × (1 − Deal closed dummy in period $t-1$)	---	---	-0.62 (0.33)	0.16 (0.16)
(b12) Own rating – average group mean rating in period $t-1$	---	---	---	-0.046 (0.083)
Period = {2, 3, …, 50}	0.021 (0.017)	-0.012 (0.012)	0.030 (0.014)	-0.013 (0.0075)
Constant	-2.44** (0.71)	0.88* (0.32)	-3.57*** (0.36)	-0.60** (0.14)
Observations	980	950	980	980
R-squared	0.621	0.78	0.643	0.696

Notes: Fixed effects linear regressions with robust standard errors clustered by group ID. The social approval (disapproval) dummy equals 1 if buyer *i*'s rating to his or her matched seller is greater than or equal to (less than) 5; 0 otherwise. $1_{\{\text{average group accepted price in period } t-1 \leq p_{sj}^{t-1}\}}$ equals 1 if the average group accepted price in period $t-1$ is less than or equal to p_{sj}^{t-1}; 0 otherwise. $1_{\{\text{average group accepted price in period } t-1 > p_{sj}^{t-1}\}}$ equals 1 if the average group accepted price in period $t-1$ is greater than p_{sj}^{t-1}; 0 otherwise. *, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

Appendix A: Predictions

A.1. Standard Theory Predictions

For each $q \in [0, 40]$, the seller, given the buyer's purchase threshold p_b, maximizes his or her payoff with respect to the price p_s:

$$max\left\{\left(p_s - \frac{1}{2}q\right) \cdot Prob\{p_s \leq p_b\}\right\}.$$

We obtain, from this maximization problem, the best response function of the seller as follows:

$$b_s(q) = \begin{cases} p_b & \text{for } 2p_b \geq q. \\ \tilde{p}\ s.t. \tilde{p} > p_b & \text{for } 2p_b < q. \end{cases} \tag{A1}$$

Likewise, given the seller's strategy $p_s(q)$, the buyer maximizes his or her expected payoff with respect to p_b as the value of the commodity is unknown to her. This reduces to the following maximization problem:

$$max\left\{\pi_b = \int_0^{40} (q - p_s(q)) \cdot 1_{\{p_s(q) \leq p_b\}} \cdot \frac{1}{40} dq\right\}. \tag{A2}$$

Suppose that $p_s(q)$ is a strictly increasing in q. Then, $\pi_b = \int_0^{40} (q - p_s(q)) \cdot 1_{\{q \leq p_s{}^{-1}(p_b)\}} \cdot \frac{1}{40} dq = \int_0^{p_s{}^{-1}(p_b)} (q - p_s(q)) \cdot \frac{1}{40} dq$. Thus, the first-order condition of the buyer is:

$$\frac{\partial \pi_b}{\partial p_b} = \frac{dp_s{}^{-1}(p_b)}{dp_b} \cdot [p_s{}^{-1}(p_b) - p_s(p_s{}^{-1}(p_b))] = \frac{dp_s{}^{-1}(p_b)}{dp_b} \cdot [p_s{}^{-1}(p_b) - p_b] = 0.$$

In other words, $p_s{}^{-1}(p_b) - p_b = 0$ since $\frac{dp_s{}^{-1}(p_b)}{dp_b} = \frac{1}{p_s{}'(p_s{}^{-1}(p_b))} \neq 0$. the condition $p_s{}^{-1}(p_b) - p_b = 0$ implies that the following condition must hold:

$$p_s(q) = q. \tag{A3}$$

This suggests that no matter what purchase threshold buyer *i* submits, the payoff of the buyer is 0 (= $q - p_s(q)$) when their deal is closed.

By contrast, suppose that $p_s(q)$ is a constant. Then, $p_b = \text{argmax}_x \left\{\pi_b = \int_0^{40} (q - p_s) \cdot 1_{\{p_s \leq x\}} \cdot \frac{1}{40} dq\right\}$ = ξ such that ξ ≥ p_s if $p_s \leq 20$ as then $\pi_b \geq 0$; but = p^* such that $p^* < p_s$ if $p_s > 20$, since then $\pi_b < 0$ if $p_s > 20$. In other words,

$$p_b \geq p_s, \text{ if } p_s \leq 20; p_b < p_s, \text{ if } p_s > 20. \tag{A4}$$

Therefore, we find two kinds of Bayesian Nash Equilibria, from the two best response functions, (A1), and (A3) or (A4). The first kind of equilibrium is the one in which that the buyer obtains expected earnings of 0 and only the seller obtains positive earnings. There are many equilibria of this kind. For instance, the following is an equilibrium: the seller proposes $p_s(q) = c$ for q such that $q \leq 2c$; and $p_s(q) = q$ for q such that $q > 2c$, and the buyer submits his or her purchase threshold, $p_b = c$, for any $c \leq 20$. In this example, the earnings of the seller are: $c - \frac{1}{2}q$, which is dependent on q.

The second kind of equilibrium is the one in which the transaction is not exerted. For example, the following is an equilibrium of this class: the seller posts a price which is greater than or equal to 20, and the buyer sets his or her purchase threshold at 0.

A.2. Inequality-Averse Preferences and Best Response Strategies

Suppose that a seller has the income inequality-averse preference as defined in the paper: $u_{sj}(\pi_{sj}, \pi_{bi}) = \pi_{sj} - \mu_j \cdot (\pi_{sj} - \pi_{bi})^2$, where $\pi_{bi} = (q - p_{sj}) \cdot 1_{\{p_{sj} \leq p_{bi}\}}$ and $\pi_{sj} = \left(p_{sj} - \frac{1}{2}q\right) \cdot 1_{\{p_{sj} \leq p_{bi}\}}$. Here, $1_{\{p_{sj} \leq p_{bi}\}} = 1$ when $p_{sj} \leq p_{bi}$; = 0 otherwise. Then, given his or her matched buyer's strategy, p_{bi}, for each $q \in [0,40]$, seller j maximizes the following payoff with respect to p_{sj}:

$$\left\{\pi_{sj} - \mu_j \cdot (\pi_{sj} - \pi_{bi})^2\right\} \cdot 1_{\{p_{sj} \leq p_{bi}\}}$$

$$= \left\{p_{sj} - \frac{1}{2}q - \mu_j \cdot \left(2p_{sj} - \frac{3}{2}q\right)^2\right\} \cdot 1_{\{p_{sj} \leq p_{bi}\}}, \tag{A5}$$

The term within the first curly bracket is maximized at: $p_{sj} = \frac{1}{8\mu_j} + \frac{3}{4}q$, as the derivative of it with respect to p_{sj} is: $1 + 6\mu_j \cdot q - 8\mu_j \cdot p_{sj}$. The value in the first curly bracket at $p_{sj} = \frac{1}{8\mu_j} + \frac{3}{4}q$ reduces to:

$$\frac{1}{4}q + \frac{1}{16\mu_j}.$$

Thus, given p_{bi}, if q is small enough that $q \leq \frac{4}{3}p_{bi} - \frac{1}{6\mu_j}$ so that $p_{sj} \leq p_{bi}$, the seller's best response function is given by: $p_{sj} = \frac{1}{8\mu_j} + \frac{3}{4}q$. By contrast, if q is large enough that $q > \frac{4}{3}p_{bi} - \frac{1}{6\mu_j}$, then, $p_{sj} = p_{bi}$ is the seller's best response function if the value in the curly bracket is still positive at $p_{sj} = p_{bi}$: $p_{bi} - \frac{1}{2}q - \mu_j \cdot \left(2p_{bi} - \frac{3}{2}q\right)^2 > 0$; otherwise, $p_{sj} > p_{bi}$ becomes his or her best response. In short, the seller's best response function is summarized as:

$$p_{sj} = \begin{cases} \frac{3}{4}q + \frac{1}{8\mu_j}, & \text{if } q \leq \frac{4}{3}p_{bi} - \frac{1}{6\mu_j}. \\ p_{bi}, & \text{if } q > \frac{4}{3}p_{bi} - \frac{1}{6\mu_j} \text{ and } p_{bi} - \frac{1}{2}q - \mu_j \cdot \left(2p_{bi} - \frac{3}{2}q\right)^2 > 0. \\ \text{any } c, \text{s.t.}\, c > p_{bi}, & \text{if } q > \frac{4}{3}p_{bi} - \frac{1}{6\mu_j} \text{ and } p_{bi} - \frac{1}{2}q - \mu_j \cdot \left(2p_{bi} - \frac{3}{2}q\right)^2 < 0. \end{cases} \quad \text{(A6)}$$

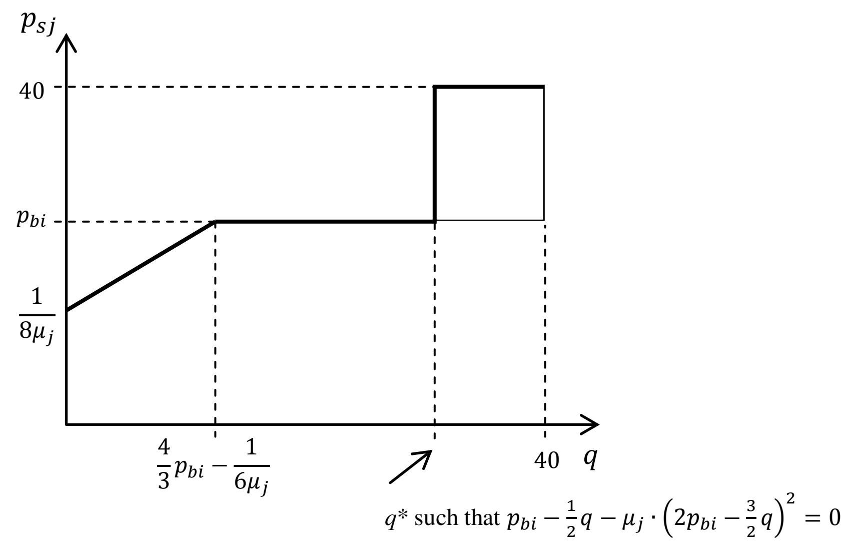


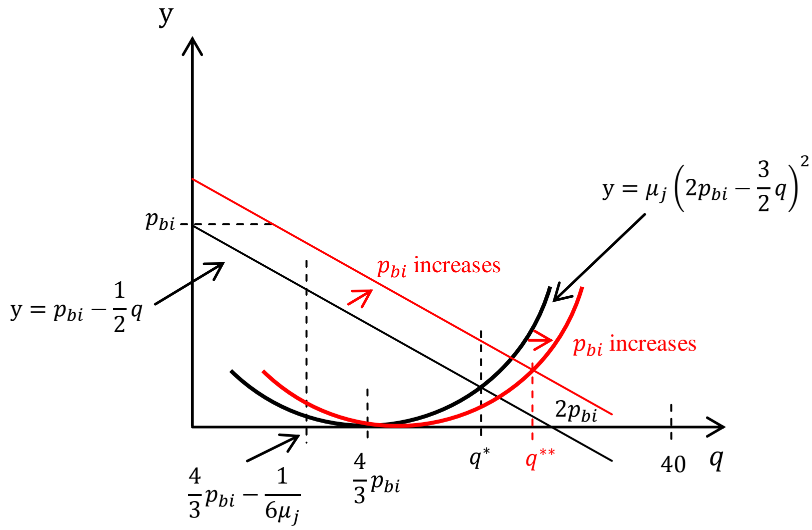
Fig. A.1: The Best Response Strategy of the Seller

Here, the acceptance rate of the offering prices is $q^*/40$ as q is randomly drawn from the uniform distribution between 0 and 40. Note that the intercept in Fig. A.1 (the seller's best response price at $q = 0$) is $\frac{1}{8\mu_j}$. This is not dependent on p_{bi}. If $p_{bi} < \frac{1}{8\mu_j}$, then the seller's best response strategy becomes as follows:

$$p_{sj} = \begin{cases} p_{bi}, & \text{if } p_{bi} - \frac{1}{2}q - \mu_j \cdot \left(2p_{bi} - \frac{3}{2}q\right)^2 > 0 \\ \text{any } c, \text{s.t.}\, c > p_{bi}, & \text{if } p_{bi} - \frac{1}{2}q - \mu_j \cdot \left(2p_{bi} - \frac{3}{2}q\right)^2 < 0. \end{cases} \quad \text{(A7)}$$

For simplicity, we assume that $p_{bi} > \frac{1}{8\mu_j}$ in the rest of this Appendix A.

Also, Note that $\frac{\partial q^*}{\partial p_{bi}} > 0$ since q^* is a point at which $\mathrm{y} = p_{bi} - \frac{1}{2}q$ and $\mathrm{y} = \mu_j \cdot \left(2p_{bi} - \frac{3}{2}q\right)^2$ intersect; and both curves shift to the right when p_{bi} increases as shown in the following figure.[35]



Thus, we find that the seller's best response strategies shift as below responding to a chance in p_{bi}.

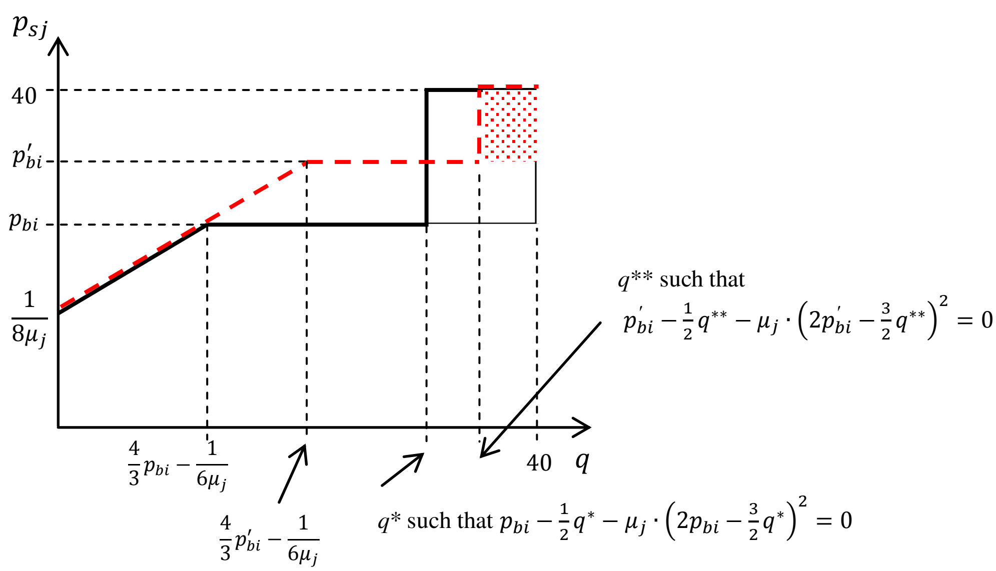


Fig. A.2: The Seller's Best Response Strategies for various p_{bi}

Note: The solid (dashed) line indicates the best response strategy of seller *j* when faced with p_{bi} (p'_{bi}).

[35] q^* can be greater than 40. In that case, the seller's best response price is less than or equal to p_{bi} for any value $q \in [0,40]$.

Likewise, suppose that the buyer also has the income inequality-averse preference as the seller: $u_{bi}(\pi_{bi}, \pi_{sj}) = \pi_{bi} - \mu_i \cdot \left(\pi_{sj} - \pi_{bi}\right)^2$. Then, the buyer's best response strategy is derived by maximizing the following his or her expected utility given the seller's strategy, $p_{sj} = p_s(q)$:

$$E_q\left[u_{bi}(\pi_{bi}, \pi_{sj})\right] = E_q\left[\left\{\pi_{bi} - \mu_i \cdot \left(\pi_{sj} - \pi_{bi}\right)^2\right\} \cdot 1_{\{p_s(q) \leq p_{bi}\}}\right]. \tag{A8}$$

That is,

$$p_b(\mu_i) = argmax_x. E_q\left[\left\{\pi_{bi} - \mu_i \cdot \left(\pi_{sj} - \pi_{bi}\right)^2\right\} \cdot 1_{\{p_s(q) \leq x\}}\right]. \tag{A9}$$

Here, suppose that $p_s(q)$ is non-decreasing in q. Then, (A8) reduces to the following:

$$E_q\left[u_{bi}(\pi_{bi}, \pi_{sj})\right] = \int_0^{p_s^{-1}(p_{bi})} \left[q - p_s(q) - \mu_i \cdot \left(2p_s(q) - \frac{3}{2}q\right)^2\right] \cdot \frac{1}{40} dq. \tag{A10}$$

Here, $p_s^{-1}(p_{bi})$ is the upper bound if it responds multiple values (correspondence). Since the condition of non-negative utility must be met, we have:

$$\int_0^{p_s^{-1}(p_{bi})} \left[q - p_s(q) - \mu_i \cdot \left(2p_s(q) - \frac{3}{2}q\right)^2\right] dq \geq 0. \tag{A11}$$

Although there are multiple equilibria, there is a common feature in that the buyer also obtains a positive material payoff in expectation in equilibrium. This is because condition (A11) implies that:

$$\int_0^{p_s^{-1}(p_{bi})} \left[q - p_s(q)\right] \; dq \geq \int_0^{p_s^{-1}(p_{bi})} \mu_i \cdot [2p_s(q) - \frac{3}{2}q]^2 dq > 0.$$

The BNE is characterized by (A6) (or A7), (A9) and (A11).

From Fig. A.2, we have the following features of the equilibria:

(1) The higher the buyer's equilibrium purchase threshold p_{bi}^*, the higher the acceptance rate.

(2) Regardless of which purchase threshold is realized in equilibrium, the seller's equilibrium price is increasing in q and less than p_{bi}^*, in a region where $q \leq \frac{4}{3}p_{bi}^* - \frac{1}{6\mu_j}$.

(3) The trade would not occur in the region where $q > q^*$.

A.3. The effects of expressing emotion on their best response strategies

The best response strategies of an income inequality-averse seller depend on μ_j (Fig. A.1). μ_j might be affected by the prevalence of the rating systems as discussed in the manuscript. The changes in the seller's best response strategies due to an affected μ_j are summarized by the following figure.

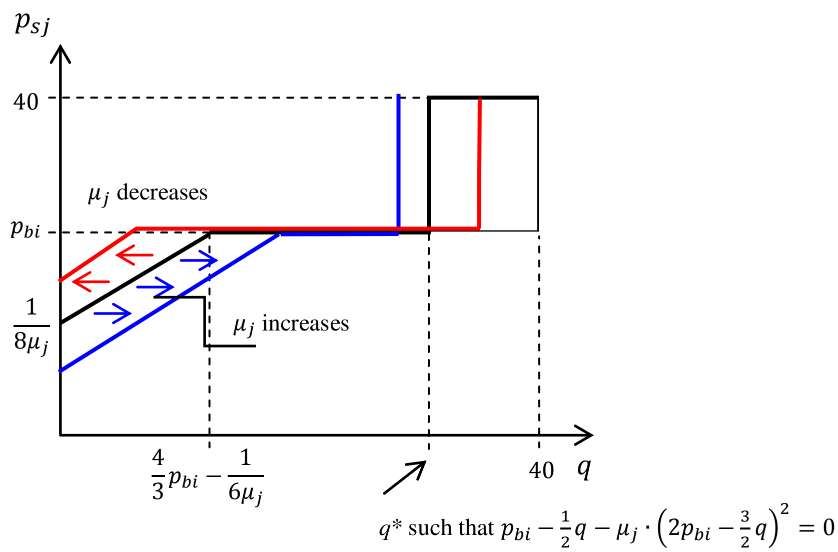
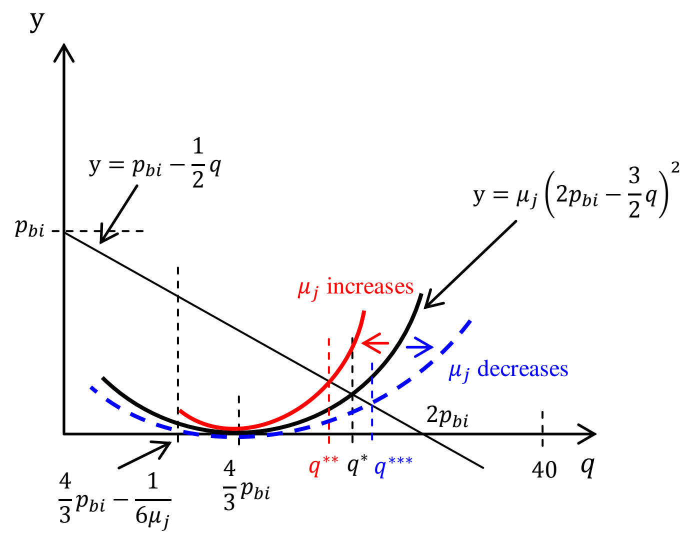


Fig. A.3: The Seller's Best Response Strategy with Affected μ_j.

Notes: In this figure, for simplicity, we assume that the purchase threshold of buyer *i* is not affected by the presence of the rating system. Notice that even if the purchase threshold is higher in the R treatment, the offering price of seller *j* is higher (lower) in the region that $q \leq \frac{4}{3}p_{bi} - \frac{1}{6\mu_j}$ if μ_j decreases (increases).

Note that $\frac{\partial q*}{\partial \mu_j} < 0$. See the following figure. q^* is a point at which $y = p_{bi} - \frac{1}{2}q$ and $y = \mu_j \left(2p_{bi} - \frac{3}{2}q\right)^2$ intersect as discussed before. When μ_j decreases (increases), q^* becomes larger (smaller). As a result, given p_{bi}, the lower (higher) μ_j, the higher (lower) acceptance rate we observe for higher q.



Together with the feature of the seller's best response strategy in that her optimal offering price stays the same, $p_{sj} = \frac{3}{4}q + \frac{1}{8\mu_j}$, in the region where $q \leq \frac{4}{3}p_{bi} - \frac{1}{6\mu_j}$ unless μ_j change (Fig. A.2), we have the predictions in the manuscript.

By contrast, the opportunity to express their emotion may make the buyer's μ (i.e., μ_i) smaller according to the recent experiments in ultimatum games with the opportunity to express emotion (Houser and Xiao 2005, Güth and Levati 2007). If μ_i decreases, then condition (A10) approaches to the condition for a selfish material payoff-maximizing buyer; and it is possible that the buyer's payoff decreases in equilibrium.

Appendix B: Additional Figures and Tables

Table B.1: The Average Offering Price and Purchase Threshold by Treatment

Treatment name	Average value of commodity	Average offering price ($\bar{p}_s$)	Average purchase threshold ($\bar{p}_b$)	Average accepted price	Average acceptance rate	Average payoff of the sellers	Average payoff of the buyers
N	20.94	18.50 (2.21)	18.76 (3.94)	16.09 (2.82)	60.6% (9.8%)	4.57 (1.24)	0.71 (1.47)
R	22.78	20.43 (2.37)	22.55 (5.08)	18.68 (2.61)	64.0% (7.4%)	5.60 (1.31)	0.68 (1.36)
SI	20.16	17.21 (1.72)	18.98 (6.29)	15.81 (2.33)	59.0% (13.0%)	3.73 (1.03)	1.78 (1.61)
SI-R	20.44	18.55 (2.23)	21.35 (5.31)	17.76 (2.12)	69.4% (8.9%)	5.55 (1.69)	1.21 (2.21)

Note: Numbers in parenthesis are standard deviations. Standard deviations are calculated using each subject's average decisions across 50 rounds; thus, the number of data in calculating each standard deviation is 20. The standard deviations of the average values of commodity are not shown because they are the same across all subjects in each session.

Table B.2: The Effects of Treatment Conditions on the Sellers' Offering Prices (Supplementing Table 2(B) in the paper)

(A) The average offering price by the value of commodities in the N treatment

q	15	16	17	18	19	20	21	22
$\bar{p}(q)$	17.8	14	16.5	20.1	18.2	18.6	18.4	19.1

q	23	24	25	26	27	28	29	30
$\bar{p}(q)$	19.6	17.8	18.5	19.6	20.0	--	20.9	21.0

(B) Regression results for restricted sets of data

Dependent variable: Seller j's offering price in period t (p_{sj}^{t})

Range of q / Independent variables	$q \leq 20$		$q \leq 21$		$q \leq 22$		$q \leq 23$		$q \leq 24$		$q \leq 25$	
	(i)	(i')	(ii)	(ii')	(iii)	(iii')	(iv)	(iv')	(v)	(v')	(vi)	(vi')
(a) Value of the commodity in period t (q_t) {= 0, 1, …, 39, 40}	0.26*** (0.013)	0.29*** (0.028)	0.27*** (0.012)	0.29*** (0.023)	0.27*** (0.011)	0.29*** (0.022)	0.28*** (0.010)	0.29*** (0.022)	0.27*** (0.0098)	0.29*** (0.021)	0.28*** (0.0090)	0.29*** (0.019)
(b) Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	-1.51* (0.90)	-1.96** (0.98)	-1.44 (0.88)	-2.06** (0.96)	-1.37 (0.85)	-2.09** (0.93)	-1.25 (0.82)	-2.14** (0.90)	-1.28 (0.81)	-2.02** (0.89)	-1.22 (0.78)	-2.11** (0.85)
(c) Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	1.65* (0.91)	2.51** (1.00)	1.64* (0.89)	2.48** (0.97)	1.59* (0.86)	2.49*** (0.94)	1.57 (0.83)	2.42*** (0.91)	1.53* (0.82)	2.44*** (0.90)	1.59** (0.78)	2.21** (0.86)
(d) Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	0.50 (1.28)	1.04 (1.38)	0.46 (1.25)	1.10 (1.35)	0.48 (1.21)	0.97 (1.31)	0.35 (1.16)	1.08 (1.26)	0.39 (1.15)	0.96 (1.25)	0.31 (1.10)	1.14 (1.20)

Interaction Terms												
(a) × (b)	---	0.048 (0.038)	---	0.063* (0.033)	---	0.070** (0.032)	---	0.078*** (0.030)	---	0.061** (0.028)	---	0.071*** (0.026)
(a) × (c)	---	-0.084** (0.039)	---	-0.081** (0.036)	---	-0.083** (0.034)	---	-0.074** (0.031)	---	-0.077*** (0.030)	---	-0.046* (0.026)
(a) × (d)	---	-0.061 (0.053)	---	-0.067 (0.050)	---	-0.048 (0.046)	---	-0.062 (0.042)	---	-0.044 (0.040)	---	-0.068* (0.036)
Own payoff in period $t-1$	0.083*** (0.023)	0.079*** (0.023)	0.082*** (0.022)	0.076*** (0.022)	0.087*** (0.022)	0.083*** (0.022)	0.085*** (0.021)	0.083*** (0.021)	0.079*** (0.020)	0.079*** (0.020)	0.072*** (0.020)	0.070*** (0.020)
Deal closed dummy in period $t-1$ {= 1 if $p_{bi}^{t-1} \geq p_{sj}^{t-1}$; 0 otherwise}	-0.041 (0.24)	-0.015 (0.24)	-0.015 (0.24)	0.030 (0.24)	-0.028 (0.23)	-0.0039 (0.23)	0.0047 (0.23)	0.028 (0.23)	0.072 (0.22)	0.077 (0.22)	0.17 (0.22)	0.20 (0.21)
Period = {2, 3, …, 50}	0.051*** (0.0058)	0.052*** (0.0058)	0.052*** (0.0057)	0.053*** (0.0058)	0.049*** (0.0056)	0.051*** (0.0057)	0.048*** (0.0055)	0.050*** (0.0055)	0.046*** (0.0053)	0.047*** (0.0053)	0.043*** (0.0052)	0.044*** (0.0052)
Constant	10.3*** (1.60)	9.95*** (1.62)	10.2*** (1.56)	9.94*** (1.58)	10.2*** (1.51)	9.96*** (1.53)	10.07*** (1.46)	9.89*** (1.47)	10.14*** (1.44)	9.9*** (1.46)	10.19*** (1.38)	10.1*** (1.40)
Observations	1,780	1,780	1,880	1,880	1,970	1,970	2,100	2,100	2,180	2,180	2,330	2,330
Log Likelihood	-4775	-4763	-5046	-5033	-5291	-5278	-5627	-5610	-5825	-5809	-6231	-6217
Wald chi^2	485.5	513.7	593.2	626.4	701.0	736.8	831.3	879.6	918.8	964.9	1110.2	1153.0
Prob > chi^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Notes: Random-effects Tobit regressions. Numbers in parenthesis are standard errors. Results are similar when random-effects linear regressions with robust standard errors clustered by group ID are used.

Besides these independent variables, the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family are included. We omitted the estimated coefficients of these variables to conserve space, since these are not related to our hypothesis. The numbers of left-(right-) censored observations are 9(1), 9(1), 9(1), 9(1), 9(1), and 9(2) in columns (i) and (i'), columns (ii) and (ii'), columns (iii) and (iii'), columns (iv) and (iv'), columns (v) and (v'), and columns (vi) and (vi'), respectively.

*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

Table B.3: The Dynamics of the Strategies of the Buyers and the Sellers (Supplementing Table 2 and Table 3 of the paper)

(A) Dependent variable: $P_{bi}^{t} - P_{bi}^{t-1}$

Independent variables	(1)	(2)
Change in the value of the commodity in period $t-1$ ($q_{t-1} - q_{t-2}$)	0.0073 (0.010)	0.0074 (0.010)
Value of the commodity in period $t-1$ (q_{t-1}) {= 0, 1, …, 39, 40}	-0.16*** (0.045)	-0.16*** (0.045)
Deal closed dummy in period $t-1$ {= 1 if $P_{bi}^{t-1} \geq P_{sj}^{t-1}$; 0 otherwise}	-7.52*** (1.03)	-7.55*** (1.03)
Value of the commodity in period $t-1$ (q_{t-1}) × Deal closed dummy in period $t-1$ {= 1 if $P_{bi}^{t-1} \geq P_{sj}^{t-1}$; 0 otherwise}	0.0989*** (0.0252)	0.098*** (0.026)
Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	-0.32 (0.40)	-0.26 (0.35)
Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	0.25 (0.36)	0.23 (0.33)
Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	0.31 (0.47)	0.21 (0.49)
Period = {3, 4, …, 50}	0.004 (0.0048)	0.0041 (0.0048)
Control Variables	No	Yes[1]
Constant	6.80*** (1.36)	6.19*** (1.39)
Observations	3,840	3,840
R-square	0.1766	0.1766
Wald chi^2	127.2	281.7
Prob > chi^2	0.000	0.000

Notes: Random effects linear regressions with robust standard errors clustered by group ID.

[1] Control variables include the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family. None of them obtains a significant coefficient. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.

*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

(B) Dependent variable: $P_{sj}^{t} - P_{sj}^{t-1}$

Independent variables	(3)	(4)
Change in the value of the commodity in period t $(q_t - q_{t-1})$	0.33*** (0.019)	0.33*** (0.019)
Deal closed dummy in period $t-1$ {= 1 if $P_{bi}^{t-1} \geq P_{sj}^{t-1}$; 0 otherwise}	-0.54*** (0.045)	-0.55*** (0.046)
Own payoff in period $t-1$	6.90*** (0.47)	6.95*** (0.47)
Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	-0.34 (0.26)	-0.36 (0.24)
Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	0.28 (0.30)	0.25 (0.30)
Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	0.0038 (0.49)	0.011 (0.48)
Period = {2, 3, …, 50}	0.0088 (0.0057)	0.0088 (0.0058)
Control Variables	No	Yes[1]
Constant	-1.90*** (0.36)	-1.90*** (0.51)
Observations	3,920	3,920
R-square	0.6344	0.6345
Wald chi^2	706.3	893.5
Prob > chi^2	0.000	0.000

Notes: Random effects linear regressions with robust standard errors clustered by group ID.
[1] Control variables include the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family. None of them obtains a significant coefficient. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.
*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

Table B.4: The Dynamics of the Strategies of the Sellers (Supplementing Table 3 (B) of the draft)

Dependent variable: $P_{sj}^{t} - P_{sj}^{t-1}$

	Treatment			
	N	SI	R	SI-R
Independent variables	(1)	(2)	(3)	(4)
$q_t - q_{t-1}$	0.34*** (0.044)	0.37*** (0.036)	0.32*** (0.038)	0.27*** (0.030)
Deal closed dummy in period *t−1* {= 1 if $P_{bi}^{t-1} \geq P_{sj}^{t-1}$; 0 otherwise}	7.77*** (1.02)	6.51*** (0.96)	10.3*** (0.82)	6.14*** (1.01)
Own payoff in period *t−1*	-0.61*** (0.079)	-0.78*** (0.093)	-0.65*** (0.051)	-0.56** (0.14)
(Maximum group accepted price in period *t−1* − P_{sj}^{t-1}) × Deal closed dummy in period *t−1*	---	0.21 (0.094)	---	0.35** (0.067)
(Maximum group accepted price in period *t−1* − P_{sj}^{t-1}) × (1 − Deal closed dummy in period *t−1*)	---	0.82*** (0.11)	---	0.70** (0.13)
(Maximum group accepted price in period *t−1* − P_{sj}^{t-1}) × (1 − Deal closed dummy in period *t−1*) × $1_{\{\text{Maximum group accepted price in period } t-1 > P_{sj}^{t-1}\}}$	---	-0.60* (0.22)	---	-0.31 (0.16)
(Own rating − 5) × Social approval dummy × Deal closed dummy in period *t−1*	---	---	-0.32* (0.11)	-0.17 (0.13)
(5 − Own rating) × Social disapproval dummy × Deal closed dummy in period *t−1*	---	---	-0.043 (0.12)	-0.022 (0.043)
(Own rating − 5) × Social approval dummy × (1 − Deal closed dummy in period *t−1*)	---	---	0.61*** (0.063)	0.42*** (0.066)
(5 − Own rating) × Social disapproval dummy × (1 − Deal closed dummy in period *t−1*)	---	---	-0.62 (0.33)	0.11 (0.14)
(Maximum group rating − Own rating) in period *t−1*	---	---	---	0.023 (0.065)
Period = {2, 3, …, 50}	0.021 (0.017)	-0.014 (0.0094)	0.030 (0.014)	-0.0040 (0.0082)
Constant	-2.44** (0.71)	-0.37 (0.39)	-3.57*** (0.36)	-1.40** (0.26)
Observations	980	950	980	980
R-squared	0.621	0.768	0.643	0.691

Notes: Fixed effects linear regressions with robust standard errors clustered by group ID. The social approval (disapproval) dummy equals 1 if buyer *i*'s rating to his or her matched seller is greater than or equal to (less than) 5; 0 otherwise. $1_{\{\text{Maximum group accepted price in period } t-1 > P_{sj}^{t-1}\}}$ equals 1 if Maximum group accepted price in period $t-1 > P_{sj}^{t-1}$; 0 otherwise. *, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

Table B.5: The Determinants of the Rating Decisions by the Buyers

(I) When their deals were closed:

Dependent variable: Rating that a buyer assigned to his or her matched seller in period t

Independent variables	(1)	(2)	(3)	(4)
Buyer's payoff in period t (i.e., $q - p_s$)	0.43*** (0.021)	0.44*** (0.020)	----	----
Seller's payoff in period t (i.e., $p_s - q/2$)	-0.10** (0.041)	-0.090** (0.040)	----	----
$\frac{\text{Buyer's payoff in period } t}{\text{Seller's payoff in period } t}$	----	----	0.67*** (0.047)	0.67*** (0.047)
SI-R Treatment dummy {= 1 for the SI-R treatment; 0 for the R treatment}	-0.061 (0.27)	-0.066 (0.22)	0.47 (0.44)	0.28 (0372)
Period = {1, 2, …, 50}	-0.010 (0.0065)	-0.010 (0.0064)	-0.019* (0.011)	-0.019* (0.011)
Control Variables	No	Yes[1]	No	Yes[1]
Constant	5.62*** (0.43)	4.75*** (0.76)	4.77*** (0.42)	4.62*** (1.17)
Observations	1,334	1,334	1,329	1,329
Log likelihood	-2343	-2321	-2924	-2915
Wald chi^2	1625.2	1679.3	208.6	228.1
Prob > chi^2	0.00	0.00	0.00	0.00

Notes: Random effects Tobit regressions. Only the observations whose deals were closed in the R or SI-R treatments are used. The numbers of left-(right-) censored observations are 301(260) in columns (1) and (2), and are 301(258) in column (3) and (4). Results are similar when random-effects linear regressions with robust standard errors clustered by group ID are used.

[1] Control variables include, for both the buyers and the sellers, the female dummies (=1 if female; 0 otherwise), the numbers of economics courses taken, the general political orientations (1 = very conservative to 7 = very liberal) and the incomes of subjects' family. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.

*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

(II) When their deals were not closed:

Dependent variable: Rating that a buyer assigned to his or her matched seller in period t

Independent variables	(5)	(6)	(7)	(8)
(a) Payoff that a buyer would have received if their deal had been closed in period t (i.e., $q - p_s$)	0.34*** (0.026)	0.33*** (0.026)	----	----
(b) Payoff that a seller would have received if their deal had been closed in period t (i.e., $p_s - q/2$)	0.067 (0.049)	0.045 (0.050)	----	----
$\frac{\text{Variable (a)}}{\text{Variable (b)}}$	----	----	0.35*** (0.045)	0.35*** (0.044)
SI-R Treatment dummy {= 1 for the SI-R treatment; 0 for the R treatment}	-1.10*** (0.32)	-1.06*** (0.34)	-1.85*** (0.42)	-1.72*** (0.42)
Period = {1, 2, …, 50}	-0.015* (0.0061)	-0.016** (0.0079)	-0.023** (0.011)	-0.023** (0.010)
Control Variables	No	Yes[1]	No	Yes[1]
Constant	4.36*** (0.67)	4.89*** (1.22)	6.29*** (0.40)	5.62*** (1.36)
Observations	666	666	664	664
Log likelihood	-1388	-1377	-1559	-1546
Wald chi^2	541.9	568.6	90.8	121.1
Prob > chi^2	0.00	0.00	0.00	0.00

Notes: Random effects Tobit regressions. Only the observations whose deals were not closed in the R or SI-R treatments are used. The numbers of left-(right-) censored observations are 97(71) in columns (5) and (6), and are 97(70) in column (7) and (8). Results are similar when random-effects linear regressions with robust standard errors clustered by group ID are used.

[1] Control variables include, for both the buyers and the sellers, the female dummies (=1 if female; 0 otherwise), the numbers of economics courses taken, the general political orientations (1 = very conservative to 7 = very liberal) and the incomes of subjects' family. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.

*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

Table B.6: The Determinants of the Acceptance Rates of Offers

Dependent variable: The acceptance rate of a transaction between buyer *i* and seller *j* in period *t*

Independent variables	(1)	(2)	(3)	(4)
(a) Value of the commodity in period *t* (q_t) {= 0, 1, …, 39, 40}	-0.030*** (0.0018)	-0.030*** (0.0018)	-0.048*** (0.0039)	-0.049*** (0.0039)
(b) Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	-0.070 (0.092)	-0.029 (0.084)	-0.72*** (0.15)	-0.69*** (0.14)
(c) Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	0.16* (0.092)	0.18** (0.085)	0.11 (0.16)	0.13 (0.16)
(d) Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	0.15 (0.13)	0.088 (0.12)	0.08 (0.22)	0.012 (0.21)
Interaction Terms				
(a) × (b)	----	----	0.030*** (0.0053)	0.031*** (0.0053)
(a) × (c)	----	----	0.0041 (0.0055)	0.0042 (0.0056)
(a) × (d)	----	----	0.0011 (0.0075)	0.00128 (0.0075)
Period = {1, 2, …, 50}	0.0050*** (0.0015)	0.0050*** (0.0015)	0.0052*** (0.0015)	0.0053*** (0.0015)
Control Variables	No	Yes[1]	No	Yes[1]
Constant	0.79*** (0.084)	0.58*** (0.18)	1.19*** (0.12)	1.00*** (0.20)
Observations	4,000	4,000	4,000	4,000
Log Likelihood	-2461	-2443	-2425	-2406
Wald chi^2	282.2	317.3	336.5	372.0
Prob > chi^2	0.000	0.000	0.000	0.000

Notes: Random-effects Probit regressions. Numbers in parenthesis are standard errors.
[1] Control variables include the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.
*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

(continuing)

Independent variables	(5)	(6)	(7)	(8)
(a') Purchase threshold of buyer i (P_{bi})	0.20*** (0.0064)	0.20*** (0.0066)	0.20*** (0.014)	0.20*** (0.014)
(b) Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	0.049 (0.14)	0.072 (0.14)	0.70** (0.32)	0.72* (0.32)
(c) Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	-0.55*** (0.14)	-0.54*** (0.14)	-1.25*** (0.41)	-1.24*** (0.41)
(d) Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	0.40** (0.20)	0.40** (0.20)	0.038 (0.53)	0.068 (0.53)
Interaction Terms				
(a') × (b)	----	----	-0.039** (0.017)	-0.039** (0.017)
(a') × (c)	----	----	0.035* (0.020)	0.035* (0.020)
(a') × (d)	----	----	0.026 (0.026)	0.024 (0.026)
Period = {1, 2, …, 50}	-0.00067 (0.0018)	-0.00056 (0.0018)	-0.00098 (0.0018)	-0.00086 (0.0018)
Control Variables	No	Yes[1]	No	Yes[1]
Constant	-3.25*** (0.15)	-3.40*** (0.29)	-3.30*** (0.26)	-3.46*** (0.37)
Observations	4,000	4,000	4,000	4,000
Log Likelihood	-1626	-1622	-1615	-1611
Wald chi^2	982.0	978.5	959.2	955.3
Prob > chi^2	0.000	0.000	0.000	0.000

Notes: Random-effects Probit regressions. Numbers in parenthesis are standard errors.
[1] Control variables include the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.
*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.

Table B.7: The Determinants of the Ratios of Payoff the Buyers Obtained to Realized q_t

Dependent variable: The payoff of a buyer divided by the value of commodity in period *t*

Independent variables	(1)	(2)
Value of the commodity in period *t* (q_t) {= 0, 1, …, 39, 40}	0.070*** (0.010)	0.070*** (0.010)
Other deal info dummy {= 1 for the SI or SI-R treatment; = 0 otherwise}	0.062 (0.063)	0.088 (0.065)
Rating dummy {= 1 for the R or SI-R treatment; = 0 otherwise}	-0.38* (0.21)	-0.35* (0.21)
Other rating info dummy {= 1 for the SI-R treatment; = 0 otherwise}	0.077 (0.34)	0.030 (0.22)
Period = {1, 2, …, 50}	-0.0025 (0.0036)	-0.0025 (0.0036)
Control Variables	No	Yes[1]
Constant	-1.67*** (0.28)	-1.68*** (0.31)
Observations	3,880	3,880
R-square	0.1905	0.1905
Wald chi^2	75.55	96.77
Prob > chi^2	0.00	0.00

Notes: Random effects linear regressions with robust standard errors clustered by group ID. Only the observations whose *q* are greater than 0 are used.

[1] Control variables include the female dummy (=1 if female; 0 otherwise), the number of economics courses taken, the general political orientation (1 = very conservative to 7 = very liberal) and the income of subjects' family. We omitted the coefficient estimates of these demographic variables to conserve space since these are not related to the hypotheses in the paper.

*, **, and *** indicate significance at the .10 level, at the 0.05 level and at the .01 level, respectively.