Fairness Ideals in Distribution Channels

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March 2014

* We thank the seminar participants at 2011 MSI Young Scholars Program, 8th triennial Invitational Choice Symposium, Annual Haring Symposium 2011, Duke University, HKUST, INFORMS Annual Conference 2009 and 2013, Marketing Science Conference 2010, Tsinghua University, Universita' Bocconi, University of Houston, and University of Toronto for their helpful comments. We also would like to thank Wilfred Amaldoss, Avi Goldfard, Joel Huber, and Teck-Hua Ho for their constructive comments. Support for this work was provided to Tony Haitao Cui through a 3M Non-Tenured Faculty Award and Carlson Dean's Small Research Grant, University of Minnesota.
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Abstract

Existing research suggests that concerns for fairness may significantly affect the interactions between firms in a distribution channel. We analytically and experimentally evaluate how firms make decisions in a two-stage dyadic channel, in which firms decide on investments in the first stage and then on prices in the second stage. We find that firms' behavior differs significantly from the predictions of the standard economic model and is consistent with the existence of fairness concerns.

Using a Quantal Response Equilibrium (QRE) model, in which both the manufacturer and retailer make noisy best responses, we show fairness significantly impacts channel pricing decisions. Additionally, we compare four principles of distributive fairness: strict egalitarianism, liberal egalitarianism, and libertarianism, previously considered in the fairness literature, and a new principle of distributive fairness — the sequence-aligned ideal that is studied first time in literature. Surprisingly, the new ideal, according to which the sequence of moving determines the formation of equitable payoff for players, significantly outperforms other fairness ideals.

Key words: fairness ideals; distribution channels; quantal response equilibrium; power; experimental economics (JEL: C72, D63)

Research in behavioral and experimental economics suggests that concerns for fairness impact a wide range of agents' behaviors.[1] Subjects in various versions of the ultimatum and dictator games routinely offer higher than optimal shares of the initial endowment, and responders virtually always turn down low offers that are significantly higher than predicted by standard economic models (Camerer 2003).

Researchers have surveyed consumers and companies to investigate what is considered fair in circumstances ranging from price increases to renting contracts, and have found that people largely agree on what is fair and what is not fair, suggesting that fairness is a widely understood concept (Anderson and Simester 2004, 2008, 2010; Güth, Schmittberger, and Schwarze 1982; Kahneman, Knetsch, and Thaler 1986a, 1986b; Olmstead and Rhode 1985). In addition, there is empirical evidence indicating that fairness/equity plays an important role in certain business contexts (Heide and John 1992; Jap 2001; Jap and Anderson 2003; Kumar, Scheer, and Steenkamp 1995; Olmsted and Rhode 1985; Scheer, Kumar, and Steenkamp 2003, Zaheer, McEvily, and Perrone 1998, Zaheer and Venkatraman 1995, etc.). For instance, in a study that surveyed 417 American auto dealers and 289 Dutch auto dealers, Scheer, Kumar, and Steenkamp (2003) found that auto dealers have concerns for distributive fairness with their business partners. Furthermore, they also found that inequity plays a very different role for dealers across cultures, with American dealers reacting only to disadvantageous inequity and Dutch dealers reacting to both disadvantageous and advantageous inequity.

There is also strong experimental support for fairness concerns from contracting agents (Fehr, Klein, and Schmidt 2007; Hackett 1994; Loch and Wu 2008). For example, Fehr, Klein, and Schmidt (2007) show that bonus contracts that offer a voluntary and unenforceable bonus for satisfactory performance provide powerful incentives and are superior to explicit incentive contracts when there are some fair-minded players. There is also ample evidence in Neuroscience and Psychology suggesting that human decision makers have intrinsic concerns for fairness (Bechara and Damasio 2005; Koenigs et al. 2007; Sanfey et al. 2003; Stephen and Pham 2008). Stephen and Pham (2008), for instance, found that decision makers' feelings of fairness and emotions play an important role in ultimatum games and negotiations.

Given the widely documented importance of fairness in various business contexts, theorists and practitioners have called attention to the issue of understanding fairness as one of the priorities for developing and maintaining healthy relations with business partners in distribution channels. For instance, Cui, Raju, and Zhang (2007) model the effect of fairness concerns on the interactions between the manufacturers and the retailer in a dyadic channel with linear demand. They demonstrate that the manufacturer can use a single wholesale price to coordinate the channel so long as the retailer has strong concerns for fairness. That is, the double marginalization problem can be avoided in such a fair channel. Caliskan-Demirag, Chen, and Li (2010) extend Cui, Raju, and Zhang (2007) to consider non-linear demand functions and find that a linear wholesale price can coordinate the channel at a wider range when the retailer is fair-minded. Pavlov and Katok (2011) find that a linear pricing contract can still maximize the channel profit even when there is information asymmetry between channel members about fairness concerns. The importance of fairness to a healthy relationship between channel members is also documented and analyzed in many other research studies.[2]

Although previous research has generated extensive useful insights on how fairness affects channel interactions, several important questions remain unanswered. How strong are the concerns of fairness in a channel? What principle is guiding the determination of the equitable payoff (i.e., what is considered as a fair deal by a player)? If a firm's decision is deviating from the prediction of the standard economic model, is it because the decision maker cares about fairness or is it because the decision maker cannot always make optimal decisions due to bounded rationality?

In order to better understand these issues, we experimentally investigate the theoretical predictions on prices in a dyadic channel where the manufacturer acts as a Stackelberg leader in choosing prices and the retailer acts as a follower, and build a Quantal Response Equilibrium (QRE) model (McKelvey and Palfrey 1995) that incorporates both retailer's concerns for fairness and the bounded rationality by both firms to explain the discrepancy between the theoretical predictions and empirical regularities. The behavioral model nests the standard economic model as a special case. Through such an enriched model, we are able to investigate how equitable payoffs are determined in a fair channel. We estimate the behavioral model from experimental data using maximum likelihood methods.

Our research makes the following contributions to the literature. 1). We provide empirical evidence that fairness matters in distribution channels and we estimate its relevance. The estimation results suggest that there are significant fairness concerns in channels. 2). We show that fairness concerns identify well entrenched preferences, and are not simply an artifact of bounded rationality. We use a two sided QRE specification to study the bounded rationality of both the manufacturer and retailer and distinguish it from behavioral concerns for fairness. To the best of our knowledge, this is the first research that analyzes the bounded rationality of both players in a dyadic channel. Using a behavioral model that incorporates both bounded rationality and fairness concerns, we quantify both effects using experimental data from incentive aligned experimental studies. 3). We investigate how a fair split of profits is determined. Our research is the first study in the literature to empirically study what is considered a fair deal in the pricing game of a distribution channel. In particular, we examine what makes an equitable division of profit between the retailer and the manufacturer. To do so we compare four fairness principles: strict egalitarianism, liberal egalitarianism, and libertarianism (Cappelen et al. 2007) with a new principle of fairness we propose, i.e., the sequence-aligned ideal. This new principle of fairness reflects the power structure in the dyadic channel and proposes that the equitable payoff should be consonant with the ratio of players' profits in the standard Stackelberg game. Hence, this fairness principle can be seen as reflecting an important element in distribution channels — the power structure in a channel. 4). We show that the fairness ideal with players' relative powers incorporated, the proposed sequence-aligned ideal, performs the best in determining what is considered fair in a channel. This suggests that in the context of channel relations, it is perceived as "fair" for the more powerful firm, i.e., the manufacturer acting as the Stackelberg leader in our model, to obtain a higher payoff than the less powerful firm, i.e., the retailer acting as a follower. This finding contributes to the literature of distribution channel by studying how power influences channel members' beliefs of deserved profits and how such beliefs affect firms' decisions and eventually guide the realization of profits for the channel.

Our paper is closely related to Cappelen et al. (2007), who studied three fairness ideals: strict egalitarianism, liberal egalitarianism, and libertarianism, in a dictator distribution game where the outputs of a production stage may determine the equitable payoff. However, our paper differs from Cappelen et al. (2007) in three important ways. 1) Our paper presents a behavioral model that incorporates both bounded rationality and fairness concerns, while Cappelen et al. (2007) only consider fairness concerns. This addition allows us to better distinguish between deviations from rational decisions due to subjects mistakes and deviations due to concerns for fairness. 2) We propose a new fairness ideal, the sequence-aligned ideal, which is studied for the first time in the literature and generalizes the concept of strict egalitarianism. This ideal is particularly suited to the channel context because it can capture power differentials between channel members. Indeed, we show that the newly proposed fairness ideal outperforms other fairness ideals in our experimental studies. 3) In our paper, players in a dyadic channel make pricing decisions in the second stage of the game, while in Cappelen et al. (2007), the dictator is deciding the amount of currency to give the passive receiver in the second stage. The active role of the retailer, who decides on retail price in the second stage of the game and can punish the manufacturer for unfair behaviors, not only provides a more realistic setting but also forces manufacturers to carefully consider retailers' preferences and concerns about fairness. Additionally, the setting in our paper is more closely related to the dyadic channel structure that is widely studied in marketing.

Our research also contributes to the literature on incorporating behavioral theories into quantitative marketing models to better understand how firms' decisions may be affected by certain behavioral factors. These include cognitive hierarchy (Camerer, Ho, and Chong 2004; Goldfarb and Xiao 2011; Goldfarb and Yang 2009), fairness concerns (Chen and Cui 2012; Cui, Raju, and Shi 2012; Cui, Raju, and Zhang 2007; Feinberg, Krishna, and Zhang 2002), bounded rationality (Che, Sudhir, and Seetharaman 2007; Chen, Iyer, and Pazgal 2010), loss and/or risk aversion (Hardie, Johnson, and Fader 1993; Kalra and Shi 2010), regret or counterfactual considerations (Lim and Ho 2007; Syam, Krishnamurthy, and Hess 2008), reference dependency (Amaldoss and Jain 2010; Ho and Zhang 2008; Orhun 2009), emotions (Sanfey et al. 2003; Stephen and Pham 2008) and learning (Amaldoss and Jain 2005; Amaldoss, Bettman, and Payne 2008; Bradlow, Hu, and Ho 2004a,b; Chen, Su, and Zhao 2012; Ho and Weigelt 1996).

The rest of this paper is organized as follows. In the next section, we outline the standard economic model with theoretical predictions on prices and investments. In subsequent sections, we describe the experimental design and report experimental results. Then, we outline a behavioral model that incorporates bounded rationality and fairness concerns by channel members. The results of the estimated model are also described in the section. We conclude with main findings from our analysis and directions for future research.

STANDARD ECONOMIC MODEL

In this section we present the standard economic model. The model provides the theoretical predictions of the investments and prices that channel members choose when they are rational profit maximizers.

Consider the standard dyadic channel where a single manufacturer sells its product to consumers through a single retailer. There are two stages. Each firm has an initial endowment of E at the beginning of the first stage. In stage one, both manufacturer and retailer simultaneously decide on the amount of investment out of their initial endowment E they would like to invest to increase the demand of the product. We denote $I_M \leq E$ as the manufacturer's investment and $I_R \leq E$ as the retailer's investment. Given their investments, the manufacturer moves first and charges a constant wholesale price w. Taking the wholesale price w as given, the retailer sets the retail price p. Without loss of generality, we assume that production cost c is given by zero. The market demand is given by $D(p) = BD - b \cdot p = a + I_M \cdot R_M + I_R \cdot R_R - b \cdot p$, where $BD = a + I_M \cdot R_M + I_R \cdot R_R$ refers to the base demand of the product, $R_M > 0$ ($R_R > 0$) represents the rate of return for the manufacturer's (retailer's) investment, and $b > 0$. We denote $\pi_M = w \cdot D(p)$ as the manufacturer's profit from sales of products and $\pi_R = (p - w) \cdot D(p)$ as the retailer's profit from sales of products. Thus, the manufacturer's total profit is given by $\prod_M(I_M, w) = E - I_M + \pi_M = E - I_M + w \cdot D(p)$ and the retailer's total profit is given by $\prod_R(I_R, p) = E - I_R + \pi_R = E - I_R + (p - w) \cdot D(p)$.

We solved the model using backward induction. Detailed proofs are given in Appendix A. We first solve the sequential pricing game given any investments by the manufacturer and retailer. Firms' investments are then solved given firms' price decisions as a function of firms' investments. Given investments I_M and I_R, the optimal wholesale price is given by $w(I_M, I_R) = \frac{a + I_M R_M + I_R R_R}{2b}$, and the optimal retail price is given by $p(I_M, I_R) = \frac{3(a + I_M R_M + I_R R_R)}{4b}$. Given firms' best-response prices and the other firm's investment, a firm's profit is a convex function of its investment, and the optimal investments are given by

(1)
$$(I_M^*, I_R^*) = \begin{cases} (0,0) & \textit{if} \quad 0 < R_M < R_{M1} \quad \textit{and} \quad 0 < R_R < R_{R1} \\ (0,E) & \textit{if} \quad 0 < R_M < R_{M2} \quad \textit{and} \quad R_R \geq R_{R1} \\ (E,0) & \textit{if} \quad R_M \geq R_{M1} \quad \textit{and} \quad 0 < R_R < R_{R2} \\ (E,E) & \textit{if} \quad R_M \geq R_{M3} \quad \textit{and} \quad R_R \geq R_{R3} \end{cases}.$$

The threshold values of return rates are defined as $R_{M1} = \frac{1}{E}(\sqrt{a^2 + 8bE} - a)$, $R_{R1} = \frac{1}{E}(\sqrt{a^2 + 16bE} - a)$, R_{M2} solved from $\Phi_M(R_{M2}, R_R) = 0$, R_{R2} solved from $\Phi_R(R_M, R_{R2}) = 0$, and R_{M3} and R_{R3} simultaneously solved from $\Phi_M(R_{M3}, R_{R3}) = 0$ and $\Phi_R(R_{M3}, R_{R3}) = 0$, where the functions Φ_M and Φ_R are given by

(2)
$$\begin{cases} \Phi_M(x,y) = E \cdot x^2 + 2(a + E \cdot y)x - 8b \\ \Phi_R(x,y) = E \cdot y^2 + 2(a + E \cdot x)y - 16b \end{cases}.$$

THE EXPERIMENT

Human subjects were recruited to act as the role of either the manufacturer or the retailer in each round. Subjects were randomly assigned to one of four treatment conditions shown in Table 1. Each player was matched in each round with a different player playing the opposite role, and played the first half of the rounds in the role of the manufacturer (retailer) and the second half in the role of the retailer (manufacturer). In the first stage of each round, the two players in the same channel simultaneously decided on the investments out of their initial endowment of E = 10 pesos. As we are interested in understanding how players determine an equitable payoff, the return rates were varied across conditions so that the return rate for the investments could be either .2 or 1.2. The variation in return rates allows us to differentiate between the effect of the contribution to the channel that is under the agents' control, i.e., the investments, and the effect of the contribution that is outside the agent's control, i.e., the effective return to investments that is affected by the exogenously given return rates. The values of the return rates were selected so that the optimal investment decision for a profit maximizing agent would be to always invest the entire endowment when facing a high return rate of 1.2 and never to invest anything when facing a low return rate of .2 irrespective of the return rate (and decision) of the other agent.

In the second stage, the player acting as the manufacturer decided on the wholesale price first. The player acting as the retailer was a follower and set the retail price after seeing the wholesale price. In the experiments the available investment levels were 0, 5, and 10 pesos and we have a = b = 1. Table 1 shows the theoretical predictions of both investments and prices.

— INSERT TABLE 1 ABOUT HERE —

A total of 154 undergraduate students from a large public university in the Midwest took part in the experiments in exchange for cash payments that are contingent on their performance in the experiments. Each session consisted of approximately 20 subjects, with the largest session having 22 subjects and the smallest session having 18 subjects. Each session lasted for 75 minutes. Subjects played 2 trial rounds to familiarize themselves with the game. Roles were randomly assigned at the beginning of the experiment and switched after half the rounds were played (e.g. a subject assigned to retailer in round 1 would play as the retailer for the first half of the session and as manufacturer for the second half of the game). In each round, each subject was matched with a different subject playing the opposite role. Subjects knew assignment was randomized and changed at every round and they did not know who they were paired with. Such a setting is important in order for the researcher to control for both the reputation effect and players' long term strategic considerations. We later show the robustness of the findings in repeated games in which each subject interacts repeatedly with a fixed partner.

The experimental procedure was as follows. At the beginning of a session, subjects were given a copy of the instructions and the researcher read the instructions aloud to subjects[3]. The researcher then answered any questions raised by subjects. At the beginning of each round, each participant was informed of her role for that round. Then, players simultaneously decided how much of the endowment to invest in the channel. As discussed above, players can choose to invest 0, 5, or 10 pesos out of their total endowment of 10 pesos. After investments were decided, players were informed about the amount of the investments, I_M and I_R, and the amount of baseline demand, $1 + I_M \cdot R_M + I_R \cdot R_R$.

In the pricing stage, the manufacturer in the channel acted as a Stackelberg leader. Hence, the manufacturer moved first to decide on a wholesale price, w, based on investments and baseline demand. The retailer moved second to decide on retail price, p, based on investments, baseline demand and wholesale price. The quantity sold was determined based on the demand function $D(p) = 1 + I_M \cdot R_M + I_R \cdot R_R - p$. For each unit sold, the manufacturer earned w pesos and the retailer earned $p - w$ pesos. After the quantity sold was determined, both firms' profits were calculated and communicated to both players. If any firm invested less than the initial endowment, the residual endowment was also added to the firm's final profit.

Subjects were paid a show up fee of $5 and a performance based sum that was computed by summing payoffs from each experimental round and then converting them to US dollars at a fixed rate. The total payment for each subject, including the show up fee, ranged between $15 and $25. The average payment to subjects was approximately $20. Subjects were paid in cash at the end of each session. The experiments were conducted using z-Tree (Fischbacher 2007).

EXPERIMENTAL RESULTS

Given our experimental setup, it is easy to compute equilibrium investments and equilibrium prices for profit maximizing agents. Table 2 reports the proportion of people choosing each investment level predicted by the standard economic model and the actual investments observed in the experiments. The table indicates that subjects' decisions systematically deviate from the equilibrium predictions and that, depending on role and condition, about 40% to 60% of subjects do not choose the equilibrium investment level.

— INSERT Table 2 ABOUT HERE —

Similarly, Table 3 compares the prices predicted by the standard economic model to the average of the actual prices observed in the experiments given the actual investments. Again, we find that observed prices are different from the optimal prices based on actual investments. The t-tests indicate a significant difference (p-value < .01) between the optimal prices and the actual prices. This suggests that, when the actual investments are taken into consideration, the prices set by players are significantly larger than the optimal prices.

— INSERT Table 3 ABOUT HERE —

Since we propose to study fairness, we also examined if there were any instances of "punishment". We reasoned that if players have concerns for fairness, they would react to an unfair decision by punishing the other member of the channel[4]. We defined a pricing decision as "punishment" if a player chose a price that brought the demand of the product to zero. Note that such punishment action effectively reduces the earnings of both players to zero, so that this action is costly not only for the player being punished, but also for the player doing the punishing. This feature implies that a rational profit maximizing player would never take such an action as it would only decrease her profit.

We run two logistic regressions to identify concerns of fairness by capturing the determinant of punishment.

(3) $$\Pr(Punishment_M) = \frac{e^{\delta_{0M} + \delta_{2M}\frac{I_M}{I_M + I_R} + \delta_{3M}\frac{I_M R_M}{I_M R_M + I_R R_R} + C_i \delta_{CiM}}}{1 + e^{\delta_{0M} + \delta_{2M}\frac{I_M}{I_M + I_R} + \delta_{3M}\frac{I_M R_M}{I_M R_M + I_R R_R} + C_i \delta_{CiM}}}$$

In the first regression the probability of manufacturer punishing the retailer is captured by Equation (3) where $Punishment_M$ is a dummy variable capturing punishment from the manufacturer, which is equal to one when manufacturer chooses a wholesale price equal to the baseline demand and zero otherwise. $\frac{I_M}{I_M + I_R}$ captures the ratio of manufacturer investment to total investment, $\frac{I_M R_M}{I_M R_M + I_R R_R}$ captures the ratio of manufacturer contribution to the demand to total contribution to the demand, and C_i is a vector of dummies capturing the experimental condition.[5]

(4) $$\Pr(Punishment_R) = \frac{e^{\delta_{0R} + \delta_{1R}\frac{\hat{w}}{w^*} + \delta_{2R}\frac{I_M}{I_M + I_R} + \delta_{3R}\frac{I_M R_M}{I_M R_M + I_R R_R} + C_i \delta_{CiR}}}{1 + e^{\delta_{0R} + \delta_{1R}\frac{\hat{w}}{w^*} + \delta_{2R}\frac{I_M}{I_M + I_R} + \delta_{3R}\frac{I_M R_M}{I_M R_M + I_R R_R} + C_i \delta_{CiR}}}$$

In the second retailer regression the probability of the retailer punishing the manufacturer is captured in Equation (4) and only the instances in which there was no manufacturer previous punishment were considered. Similarly to the manufacturer's case, $Punishment_R$ is a dummy variable that captures punishment from the retailer, which is equal to one when the retailer chooses a retail price equal to the baseline demand and zero otherwise. The regressors are the same as for the manufacturer regression. In addition, we included a term capturing the magnitude of the manufacturer's deviation from the optimal price, $\frac{\hat{w}}{w^*}$, the ratio of the actual price chosen by the manufacturer to the optimal price given the baseline demand.

— INSERT Table 4 ABOUT HERE —

We find that manufacturers resort to punishment for 20% of their decisions, while retailers punish in about 22% of those decision instances in which they have not been punished. Moreover, we find (Table 4) that both δ_2 and δ_3 are not significant, i.e., neither investments nor contribution to demand have an impact on punishment decisions.

The decision to punish other players despite its costly consequences to themselves suggests that players are not purely self-interested. In addition, the significance of δ_1 implies that the retailer's punishment is a rather systematic consequence of manufacturer's action. The retailer is more likely to punish the more the manufacturer deviates upwards from optimal wholesale price. This systematic behavior suggests that punishment is retaliation for manufacturer's attempts of taking advantage of its first mover role by charging a high wholesale price, thereby suggesting that the retailer might perceive this kind of decisions as unfair.

CAPTURING EMPIRICAL REGULARITIES

The experimental data shows that both wholesale and retail prices are significantly different from the predictions of the standard economic model and that channel members are willing to punish each other even when such punishment is costly. We explain these results by generalizing the standard economic model to incorporate fairness concerns that can affect the interactions between channel members significantly (Kumar 1996; Kumar, Scheer, and Steenkamp 1995; Loch and Wu 2008). Besides fairness concerns, another possible reason for players to set prices different from predictions of the standard economic model is bounded rationality, i.e., players are trying to maximize profits but making mistakes in their decisions. In order to identify the bounded rationality in price decision making, we employ the Quantal Response Equilibrium (QRE) model (McKelvey and Palfrey 1995).

We start with a discussion of the fairness ideals which determine the equitable payoff for a fair-minded firm. Next we analyze the QRE model that incorporates fairness concerns expressed by different fairness ideals. Finally we estimate the QRE model with fairness concerns using the experimental data.

Fairness Ideals

We use the model of distributive fairness (Fehr and Schmidt 1999) to conceptualize fairness concerns between channel members (Kumar, Scheer, and Steenkamp 1995; Cui, Raju, and Zhang 2007). A firm with concerns for distributive fairness experiences disutility from inequity in the allocation of payoffs. The negative effect of inequity is stronger when the firm has a lower payoff compared with its equitable payoff (i.e., when a disadvantageous inequity occurs) than when the firm has a higher payoff (i.e., when an advantageous inequity occurs). The equitable payoff is the amount of monetary payoff a firm considers a fair deal.

We follow Cui, Raju, and Zhang (2007) and assume that the retailer in the channel displays concerns for fairness, while the manufacturer is a profit maximizer. The manufacturer's and retailer's payoffs from sales of product are denoted, respectively, as π_M and π_R, the retailer's utility is given by

(5) $$U_R = \Pi_R - \alpha \cdot \max\{\frac{\tau}{1-\tau}\pi_M - \pi_R, 0\} - \beta \cdot \max\{\pi_R - \frac{\tau}{1-\tau}\pi_M, 0\},$$

for $\alpha \geq \beta$, and $0 < \beta < 1$.[6] The terms in parentheses are used to distinguish between advantageous and disadvantageous inequity. To represent an agent that is more adverse to disadvantageous inequity than advantageous inequity, it is further assumed $\alpha \geq \beta$.

In the utility function, different values of $\frac{\tau}{1-\tau}$ represent different fairness ideals. The fairness ideal captures how a player's equitable payoff is determined. What is considered fair by players can vary as a result of social norms and power structure, as well as to the contributions of the players to the final payoff. Our experimental setup, in which the investments of different players affect both the base demand of the product and firms' profits, is similar to an economy with investment-dependent market demands. In such a context, what is considered as a fair profit allocation can depend on the concept we use to define fairness, the so-called fairness ideal. The three most prominent fairness ideals studied in literature thus far are: strict libertarianism, strict egalitarianism, and liberal egalitarianism (Cappelen et al. 2007).

Strict egalitarianism claims that agents should get the same share of the final outcome, irrespective of their respective contributions. Strict libertarianism argues that agents' payoffs should be in agreement with their total contributions, including the factors under their control, i.e., investments, and the factors outside of their control, i.e., return rates on investments. Liberal egalitarianism takes a middle ground position, arguing that agents' final profits should be divided in proportion to their contributions that are under their control, i.e., in this case, investments.

In addition, we propose a fourth fairness ideal, termed the sequence-aligned ideal. According to this ideal, the players' payoff should be consonant with the share of channel profit it would obtain in the standard Stackelberg pricing model, in which the manufacturer and the retailer sequentially set prices to maximize respective profits. Therefore, when the manufacturer is the Stackelberg leader in a pricing game, the equitable payoff for the retailer would equal one-third of the total channel profit, or one-half of the manufacturer's profit. The higher profit for the Stackelberg leader comes from its advantage in power relative to the follower, which grants the leader with a higher profit than the follower. Thus, the newly proposed sequence-aligned ideal indicates that the equitable payoffs for the firms should be consistent with the power structure in the channel. To our best knowledge, this is the first research empirically testing how power structure in channel affects the formation of equitable payoffs for channel members.

Note that the strict egalitarian ideal can be seen as a special case of the sequence-aligned ideal. When both firms have the same power in the channel, they deserve to have equal share of the total profit under the sequence-aligned ideal, a division of profits that coincides with the split under the strict egalitarian ideal. Hence, the use of a Stackelberg game is essential to separate the strict egalitarian and the sequence aligned ideal.

Given our experimental design, each of all four fairness ideals can be represented by a unique value of τ.[7] A value of $\tau = \frac{1}{2}$ corresponds to the strict egalitarian ideal. This is because the retailer's equitable payoff is equal to the manufacturer's profit from sales of product, i.e., $\frac{\tau}{1-\tau}\pi_M = \pi_M$, when $\tau = \frac{1}{2}$. A value of $\tau = \frac{1}{3}$ will successfully represent the sequence-aligned ideal in a standard

Stackelberg pricing game since $\frac{\tau}{1-\tau}\pi_M = \frac{\pi_M}{2}$ for $\tau = \frac{1}{3}$, i.e., the retailer's equitable payoff is proportional to its payoff in a standard Stackelberg game. In a similar fashion, we can show that the value of τ with the liberal egalitarian ideal is given by

$$\tau = \begin{cases} \frac{1}{2} & if \quad I_M = I_R = 0 \\ \frac{I_R}{I_M + I_R} & otherwise \end{cases},$$

and the value of τ with the strict libertarian ideal is given by

$$\tau = \begin{cases} \frac{1}{2} & if \quad I_M = I_R = 0 \\ \frac{I_R \cdot R_R}{I_M \cdot R_M + I_R \cdot R_R} & otherwise \end{cases}.$$

In Table 5, we summarize these four fairness ideals for ease of reference. Note that both the strict egalitarian ideal and the sequence-aligned ideal generate equitable payoffs that are independent of firms' investments, while the retailer's equitable payoffs under both the liberal egalitarian ideal and the strict egalitarian ideal depend on both firms' payoffs that are affected by their investments.

— INSERT Table 5 ABOUT HERE —

Quantal Response Equilibrium (QRE) Model with Fairness Ideals

It is worthy of pointing out the importance of considering bounded rationality in our behavioral model of fairness. Both bounded rationality and fairness concerns may induce players to deviate from the optimal decisions predicted by the standard economic model. To discover whether fairness is simply an artifact of a deviation from perfect rationality or is an intrinsic preference by the players, we need to figure out whether fairness concerns survive after controlling for bounded rationality. In order to solve this issue, we use a QRE model to capture the deviations from perfect rationality by channel members (Chen, et al. 2012; McKelvey and Palfrey 1995; Ho and Zhang 2008; Lim and Ho 2007). Specifically, using a QRE model allows us to answer the following questions: 1) What is the driving force for deviations in players' decisions? Are deviations due to fairness concerns, bounded rationality, or both? 2) Can we differentiate fairness concerns and bounded rationality from each other and quantify them? 3) Are the manufacturer and retailer both equally boundedly rational in the game?

The key idea of the QRE framework is that decision makers will not always make the optimal decision but they will make better decisions more often. This idea can be operationalized using a logit model. If we assume that decision makers make suboptimal choices that are subject to random errors that are *i.i.d.* as an extreme value distribution, then the probability of choosing any given option can be computed using a logit specification. More specifically, the probability for the retailer to choose a retail price at level p_j is given by

(6) $$prob(p = p_j) = \frac{e^{\lambda_R U_R(p_j)}}{\sum_k e^{\lambda_R U_R(p_k)}},$$

where the parameter λ_R refers to the degree of Nash rationality of the retailer and increases as the retailer becomes more rational. It can be easily proved that when $\lambda_R = 0$, the probabilities for the retailer to choose each price level are the same, and the retailer is randomly choosing a price level. Intuitively, this happens because the weight attached to the utility carried by each choice is zero. On the contrary, when $\lambda_R = \infty$, the retailer will choose the optimal price level with a probability of one. In fact, in contrast to the case where $\lambda_R = 0$, in this case the weight attached to the utility carried by each choice is infinity, so that the choice with the highest utility will always be chosen.

Hence, the QRE specification nests both perfect rationality and random choice in a flexible specification. Moreover, it has the advantage of requiring only minimal assumptions on the behavioral data. In fact, while the QRE specification requires the econometrician to compute and compare the exact utility yielded by each alternative observed by a player, it only assumes that players choose a better alternative more often than a worse alternative.

Estimation and Results

We develop a series of models to estimate fairness and QRE parameters using the data from the pricing stage. We can group the models into two categories: 1) the base model in which both agents are boundedly rational and don't learn over time; and 2) the learning model in which both agents are boundedly rational and learn over time.

Since using a QRE specification requires discrete data and the prices in our model are continuous, we separated the data into three equally sized intervals and used the central value of each bin to compute profits and utility.[8] For example, since the feasible range for the retail price is between w and BD, the three available bins for the retail price were chosen as: 1) w to $\frac{BD-w}{3}$; 2) $\frac{BD-w}{3}$ to $\frac{2(BD-w)}{3}$; and 3) $\frac{2(BD-w)}{3}$ to BD. If the retailer chose a price in the first interval we used $p=\frac{BD-w}{6}$; the second bin, $p=\frac{BD-w}{2}$; and the third bin, $p=\frac{5(BD-w)}{6}$. We opted to divide the intervals in equally sized bins instead of using distributional characteristics (e.g., percentiles) because each observation has a different pricing space, making it difficult to determine valid cutoff points for the whole sample. We summarize the notation used for the parameters in Table 6.

— INSERT Table 6 ABOUT HERE —

Base model

First, we estimated a base model using data from the pricing stage and assuming the manufacturer and retailer are both boundedly rational. Note that when the manufacturer decides on the wholesale price *w*, she does not know for sure what retail price, *p*, will be chosen by the boundedly rational retailer. As a result, the manufacturer must make a decision based on the expected profit she would get from each possible wholesale price level. On the contrary, when the retailer chooses the retail price, the wholesale price is already known. Hence, the manufacturer is facing a more complicated decision when setting wholesale prices than the retailer, who decides on the retail price *p* only after observing the wholesale price *w*. Under this framework, the log-likelihood for the estimation can be represented as follows,

(7) $$LL = LLM + LLR$$

where

(8)
$$\begin{aligned} LLM &= \sum_n \sum_i y^{w=w_i} \log(prob(w=w_i)) = \sum_n \sum_i y^{w=w_i} \log\left(\frac{e^{\lambda_M E\pi_M(w_i|p_j)}}{\sum_k e^{\lambda_M E\pi_M(w_k|p_j)}}\right) \\ &= \sum_n \sum_i y^{w=w_i} \log\left(\frac{e^{\lambda_M \sum_j prob(p=p_j)\cdot\pi_M(w_i|p_j)}}{\sum_k e^{\lambda_M \sum_j prob(p=p_j)\cdot\pi_M(w_k|p_j)}}\right) \end{aligned}$$

and

(9) $$LLR = \sum_n \sum_j y^{p=p_j} \log(prob(p=p_j)) = \sum_n \sum_j y^{p=p_j} \log\left(\frac{e^{\lambda_R U_R(p_j)}}{\sum_k e^{\lambda_R U_R(p_k)}}\right).$$

Here U_R is the utility given by Equation (3), $\pi_M = D(p)\cdot w$, and λ_M and λ_R are, respectively, the QRE parameters for the manufacturer and the retailer.[9] Note that the probabilities of different retail prices affect the probabilities for the manufacturer to choose different wholesale prices. This requires simultaneously estimating the log-likelihoods for both manufacturer and retailer, i.e., *LLM* and *LLR*.

We estimated different variants of this base model. First, a model was run with no concerns for fairness and used as a baseline to check whether considering fairness concerns improves the explanatory power of the model. Next, we ran the four models corresponding to the four different fairness ideals.

The estimation results are presented in Table 7. As we can see from the table, all the models that account for fairness have a significantly better fit than the baseline model where no fairness is considered. The AIC and BIC values suggest that the fairness ideal best capturing subjects' behaviors is the sequence-aligned ideal, which suggests that there are significant concerns for distributive fairness in a channel where both players are boundedly rational.

— INSERT Table 7 ABOUT HERE —

The parameter of disadvantageous inequity α is equal to .39 and is significantly different from zero in the sequence-aligned model (p-value < .01). The parameter of advantageous inequity β is given by .10, directional but insignificant (p-value = .50). Note that the manufacturers' beliefs on retailers' preference play a role in the estimated parameters, hence the insignificant result might be due to manufacturers believing that retailers do not care about advantageous inequality.

Since both α and β are positive, the data suggests that an increase in inequity decreases retailer's utility (see Equation (3)) and players care about disadvantageous and advantageous inequity. That is, concerns exist regarding distributive fairness in the channel. In addition, since $\alpha > \beta$, the estimation confirms that players are more dissatisfied with experiencing disadvantageous than advantageous inequity.

Finally, note that both players are boundedly rational. In particular, the QRE parameter for the retailer in the full model is given by $\lambda_R = .08$, while the QRE parameter for the manufacturer is $\lambda_M = .02$. Since a lower QRE parameter implies a higher rate of mistakes, the estimated results indicate that the manufacturer is more prone to mistakes when choosing prices than the retailer. Intuitively, the difference in the QRE parameters can be attributed to the manufacturer's facing more complicated decisions than the retailer. This is consistent with the experimental setup in which the manufacturer has to anticipate the retailer's boundedly rational responses when deciding on the wholesale price, while the retailer sets retail price *p* after observing the wholesale price *w*.

Learning model

In addition to the base model, we estimated a model in which subjects are allowed to learn over time (Camerer and Ho 1999; Camerer, Ho, and Chong 2002, 2003; Chen, et al. 2012).[10] To represent learning we let the QRE parameter change over time according to the following:

(10) $$\lambda_i(t) = \lambda_i + (\theta_i - \lambda_i)e^{-\delta(t-1)}.$$

where *i* indicates whether the subject is a retailer or a manufacturer and the brounded rationality parameter $\lambda(t)$ decays exponentially over time.

Note that $\lambda_i(1) = \theta_i$ and $\lambda_i(\infty) = \lambda_i$. Therefore, θ_i can be interpreted as the initial rationality parameter, λ_i as the eventual rationality parameter, and δ captures the rate of learning. Given the manufacturer and the retailer face different decision situations, we assume the initial and the final rationality parameters to be different for different type of players, while we assume players are all learning at the same rate.

As for the base model, we run a series of models that allow us to compare the standard model without fairness to the models incorporating different fairness ideals. We find once again that the model allowing for fairness dominates the standard model and that the fairness ideal that best represents data is the sequence-aligned ideal (see Table 8).

— INSERT TABLE 8 ABOUT HERE —

In the interest of space, we limit our discussion to the best fitting model, i.e. the sequence-aligned model. Once again, we find that the parameter for disadvantageous inequity is significant, which implies that the retailer experiences disutility when its profit is less than half of the manufacturer's profit. Additionally, initial rationality parameter indicates that subjects are boundedly rational. The learning parameter is not significant, suggesting that there is no significant learning over time. This inability to learn might be due to the experimental protocol which randomly matches subjects at each round. The random matching might limit learning because it makes the game a one shot game.

In general, the results of the model with learning are comparable to the ones of the base model without learning. Comparing across models the fairness parameters are similar with both disadvantageous inequity parameters significant and not significantly different and both advantageous inequity parameters not significantly different from zero. The bounded rationality parameters are also consistent suggesting that subjects are boundedly rational and retailer tend to make fewer mistakes than manufacturer. As for the base model, we speculate that the difference between the rationality parameters in the learning model is due to the higher complexity of the game faced by the manufacturer.

Robustness Check

Fixed matching protocol

So far we have focused on one shot games because the absence of strategic consideration makes it a cleaner test of fairness. However, it might be interesting to examine what happens when subjects play a repeated game with fixed opponents.[11] We run an additional set of experiments in which subjects' matching was fixed (i.e. each subject always played with the same player for the entire game). The experimental procedure was identical to the one described above with the exception that subjects were randomly matched only in the first round and they maintained the same opponent they faced in the first round for the rest of the game. 76 subjects participated in this additional experiment.

We followed the same procedure as described above for the estimation. We estimated a base model and a model with learning. In both models we compared the standard model where no concerns for fairness are allowed with the four models describing the four fairness ideals.

Consistent with the results for the one-shot game, we find that the standard model performs worse than the fairness models in both the base model (see Table 9) and the model with learning (see Table 10). Moreover, we find that the fairness ideal that best describes the data is still the sequence-aligned ideal.

— INSERT Table 9 ABOUT HERE —

Focusing on the sequence-aligned ideal in the base model (Table 9), not only the disadvantageous inequity parameter but also the advantageous inequity parameter are significant, indicating that retailers perceive disutility not only when they are earning less than their equitable payoff but also when they are earning more than that. This provides strong support for fairness concerns and also indicates that subjects might be more sensitive to fairness concerns when they interact with each other repeatedly. Moreover, while subjects are still boundedly rational, in the fixed matching protocol retailers display a higher λ than in the random matching protocol. This might be due to learning.

— INSERT TABLE 10 ABOUT HERE —

Indeed when we explicitly account for learning (Table 10), we did find strong evidence that subjects are learning over time. Both the learning rate and the final rationality parameter are significant and positive, indicating that subjects are making fewer mistakes in the later rounds of the game. Finally, the fairness parameters confirm the results of the base model and indicate that retailers care about both advantageous and disadvantageous inequity in the learning model.

DISCUSSION AND CONCLUSION

In this paper, we experimentally investigated the theoretical predictions on prices in a dyadic channel, where the manufacturer acts as a Stackelberg leader in setting prices, and the retailer acts as a follower. A behavioral model that incorporates both retailer's concerns for fairness and bounded rationality by both firms is proposed to explain the discrepancy between the theoretical predictions and the empirical regularities. Through such an enriched model, we investigate how equitable payoffs are determined in the fair channel, and propose a new principle of fairness (i.e., fairness ideal) that has never been investigated in literature. Our research makes several contributions to the literature.

First, to the best of our knowledge, our research is the first to empirically study fairness ideals in distribution channel. We provide an estimation of fairness parameters in a channel context. The estimation results suggest that there are significant fairness concerns in channels. In particular, we find that players are adverse to both advantageous and disadvantageous inequities, and they display a greater aversion for disadvantageous inequity than for advantageous inequity. This research finding provides evidence that fairness can significantly affect firms' decisions in channel and thereby offers support to the notion that fairness can modify channel relations.

Second, our research contributes to the understanding of the determinants of equitable payoffs between fair-minded agents in business relations. We compare three commonly proposed fairness principles (Cappelen et al. 2007), i.e. strict egalitarian, liberal egalitarian and strict libertarian, with a newly proposed principle of fairness that is studied the first time in literature — the sequence-aligned ideal that reflects the power structure of the channel. The comparison between the principles suggests that the sequence-aligned ideal significantly outperforms other ideals in describing subjects' behaviors in our experiments. The newly established ideal is particularly interesting and important because it reflects the concept that the equitable payoff for the retailer is consonant with the ratio of players' profits in the standard Stackelberg game and suggests that power structure does affect what is perceived as "fair". This finding indicates that it is fair for the more powerful firm, i.e., the manufacturer as a Stackelberg leader in our model, to obtain a higher payoff than the less powerful firm, i.e., the retailer as a follower. This finding contributes to the literature of distribution channel by showing how power influences channel members' beliefs of deserved profits and how such beliefs affect firms' decisions and eventually guide the realization of profits for all the members in a channel.

Last but not least, our study includes both inclinations for social preferences and bounded rationality, and we differentiate and quantify both effects through incentive aligned experimental studies. On one hand, we find that both manufacturers and retailers make errors in their decisions, although to different extents. Since the manufacturer is the first mover in a Stackelberg game and sets its wholesale price before the retailer decides on the retail price, the manufacturer faces a more complex task than the retailer. This is confirmed by our estimation: the QRE parameter for the manufacturer is significantly smaller than that for the retailer, indicating that the manufacturer is less rational than the retailer. Moreover, when subjects interact repeatedly with the same opponent they learn more than when they interact with different opponents. On the other hand, we also find that even after accounting for such bounded rationality, fairness concerns still significantly affect firms' decisions. This implies that deviations in players' pricing decisions from predictions of the standard economic model are not entirely due to errors in their decision making — concerns for fairness indeed can be an important factor influencing the interactions between firms in distribution channels.

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FOOTNOTES

[1] A short list of research on this topic includes: Anderson and Simester 2004, 2008, 2010; Camerer 2003; Charness and Rabin 2002; Fehr, Klein, and Schmidt 2007; Fehr and Schmidt 1999; Goldfard et al. 2012; Güth, Schmittberger, and Schwarze 1982; Hackett 1994; Ho and Su 2009; Kahneman, Knetsch, and Thaler 1986a, 1986b; Macneil 1980; Olmstead and Rhode 1985, and Rabin 1993.

[2] The research includes: Anderson and Weitz 1992; Caliskan-Demirag, Chen, and Li 2010; Corsten and Kumar 2003, 2005; Frazier 1983; Hackett 1994; Katok and Wu 2009; Kaufmann and Stern 1988; Kumar 1996; Kumar, Scheer, and Steenkamp 1995; Loch and Wu 2008; Macneil 1980; McCharty 1985; Meyer et al. 2010; Olmstead and Rhode 1985; Scheer, Kumar, and Steenkamp 2003.

[3] See Appendix B for the instructions used in experiment 2 with $R_M = .2$ and $R_R = .2$. The instructions for other conditions are available from the authors upon request.

[4] This intuition was prompted by informal debriefing talks with subjects. When asked why they choose such high prices, subjects replied that was their way of punishing the other player for charging a wholesale price that was too high.

[5] The baseline condition is R_R=0.2 and R_M=0.2, while for C_1 R_R=0.2 and R_M=1.2, for C_2 R_R=1.2 and R_M=0.2, and for C_3 R_R=1.2 and R_M=1.2.

[6] We assume the retailer compares profit from sales of product π_R with equitable payoff $\frac{\tau}{1-\tau}\pi_M$, which is a function of the manufacturer's profit from sales of products as well. The reason for such a specification is that firms' pricing decisions in the pricing stage will affect only their profits from sales of product, given their investment amounts. The residual of endowment, $E - I_j$ ($j = M, R$), on the other hand, is independent of firms' pricing decisions.

[7] Since α and β measure the degree of fairness concerns for a decision maker but not his belief about what kind of deal is fair, they are independent of the fairness ideal. Therefore, we cannot use parameters α and β to test different fairness ideals. We thank the anonymous AE for suggesting us to consider this issue.

[8] We also varied the number of intervals used to discretize our variables by using 3, 5, 7, and 9 intervals to discretize the retail price. We did not see significant differences between the models.

[9] We estimated the maximum likelihood using the fmincon routine in Matlab. Parameters were restricted to respect the assumptions of the theory ($\alpha \geq \beta \geq 0$, $\lambda_R \geq 0$, and $\lambda_M \geq 0$)

[10] We thank the anonymous AE and reviewers for suggesting to incorporate this analysis.

[11] We thank the anonymous AE and reviewers for suggesting to incorporate this analysis.

TABLE 1: PREDICTION OF THE STANDARD ECONOMIC MODEL

Investments Prices		Retailer	
		R_R = 1.2	R_R = .2
Manufacturer	R_M = 1.2	10.00, 10.00 12.50, 18.75	10.00, 0 7.50, 10.75
	R_M = .2	0, 10.00 7.50, 10.75	0, 0 .50, .75

Note: the first (second) number in each row in a cell refers to the decision by the manufacturer (retailer). The first row shows investments and the second row shows prices.

TABLE 2: OPTIMAL AND ACTUAL INVESTMENT CHOICES

			Investment		
			0	**5**	**10**
Retailer	R_R **= .2**	optimal	100.00%	0.00%	0.00%
		actual	62.70%	24.17%	8.56%
	R_R **= 1.2**	optimal	0.00%	0.00%	100.00%
		actual	31.85%	30.51%	37.63%
Manufacturer	R_M **= .2**	optimal	100.00%	0.00%	0.00%
		actual	66.11%	24.30%	9.59%
	R_M **= 1.2**	optimal	0.00%	0.00%	100.00%
		actual	15.60%	23.76%	60.64%

TABLE 3: OPTIMAL AND ACTUAL PRICES GIVEN ACTUAL INVESTMENTS

			Retailer			
			R_R **= 1.2**		R_R **= .2**	
			w	***p***	***w***	***p***
Manufacturer	R_M **= 1.2**	**Optimal Price**	8.65	12.97	4.91	7.37
		Standard Deviation	3.18	4.76	2.43	3.65
		Actual Price	9.73	13.92	5.32	7.89
		Standard Deviation	4.23	5.20	3.07	4.06
		***t*-test**	-6.34***	-6.75***	-3.43***	-5.41***
	R_M **= .2**	**Optimal Price**	3.66	5.49	.78	1.17
		Standard Deviation	2.53	3.80	.41	.62
		Actual Price	4.18	5.86	1.09	1.39
		Standard Deviation	3.39	4.15	.73	.76
		***t*-test**	-5.10***	-5.07***	-11.19***	-13.64***

*** indicates that the *t*-test between actual and optimal values is significant at .01 confidence level.

TABLE 4: PREDICTORS OF PUNISHMENT

	$Punishment_M$	$Punishment_R$
δ_1	-	1.744
		(0.194)***
δ_2	0.0192	-0.532
	(0.618)	(0.632)
δ_3	-0.579	0.720
	(0.623)	(0.670)
δ_{C1}	-0.854	-0.631
	(0.192)***	(0.240)***
δ_{C2}	-1.233	-0.682
	(0.185)***	(0.229)***
δ_{C3}	-2.414	-1.519
	(0.272)***	(0.235)***
δ_0	-0.161	-2.619
	(0.155)	(0.304)***
Observations	1,468	1,167
Pseudo R-squared	0.0918	0.105
Log Likelihood	-676.4	-551.9
AIC	1364.72	1117.76
BIC	1396.47	1153.2

Standard errors in parentheses

*** p-value < 0.01, ** p-value < 0.05, * p-value < 0.1

TABLE 5: FAIRNESS IDEALS

Fairness Ideals	τ
Sequence-Aligned	$\frac{1}{3}$
Strict Egalitarian	$\frac{1}{2}$
Liberal Egalitarian	$\frac{1}{2}$, if $I_M = I_R = 0$; $\frac{I_R}{I_M + I_R}$, otherwise
Strict Libertarian	$\frac{1}{2}$, if $I_M = I_R = 0$; $\frac{I_R \cdot R_R}{I_M \cdot R_M + I_R \cdot R_R}$, otherwise

TABLE 6: NOTATION OF ESTIMATION RESULTS

λ_R	QRE parameter of the retailer
λ_M	QRE parameter of the manufacturer
α	Parameter of disadvantageous inequity
β	Parameter of advantageous inequity
τ	Parameter of fairness ideal

TABLE 7: ESTIMATION RESULTS OF THE BASE MODEL

	α=β=0	Sequence-Aligned	Strict Egalitarian	Liberal Egalitarian	Strictly Libertarian
λ Retailer	.10	.08	.09	.09	.09
	(.01)***	(.01)***	(.01)***	(.01)***	(.01)***
λ Manufacturer	.02	.02	.02	.02	.02
	(.00)***	(.00)***	(.00)***	(.00)***	(.00)***
α	-	.39	.13	.06	.01
		(.10)***	(.04)***	(.03)**	(.01)
β	-	.10	.00	.00	.00
		(.15)	(.17)	(.16)***	(.15)
Observations	4404	4404	4404	4404	4404
LL	-3131.8	-3117.23	-3121.56	-3129.18	-3131.43
vs. α=β=0	-	29.14***	20.48***	5.24*	0.74
AIC	6267.6	6242.46	6251.12	6266.36	6270.86
BIC	6280.381	6268.021	6276.681	6291.921	6296.421

Note: Standard errors are shown in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 8: ESTIMATION RESULTS OF THE MODEL WITH LEARNING

	α=β=0	Sequence-Aligned	Strict Egalitarian	Liberal Egalitarian	Strict Libertarian
θ_R	.06	.05	.05	.05	.06
	(.02)***	(.01)***	(.01)***	(.01)***	(.02)***
λ_R	.16	.27	.19	.16	.16
	(.05)***	(.71)	(.17)	(.08)**	(.06)***
θ_M	.01	.02	.02	.02	.02
	(.01)***	(.00)***	(.01)***	(.01)***	(.01)***
λ_M	.03	.05	.04	.03	.03
	(.01)***	(.10)	(.02)	(.01)***	(.01)***
δ	.18	.04	.10	.15	.18
	(.19)	(.16)	(.18)	(.18)	(.19)
α	-	.42	.15	.07	.01
		(.10)***	(.04)***	(.03)**	(.01)
β	-	.00	.00	.00	.00
		(.17)	(.17)	(.15)	(.14)
Observations	4404	4404	4404	4404	4404
LL	-3124.99	-3109.48	-3110.28	-3121.69	-3124.34
vs. α=β=0	-	31.02***	29.42***	6.6**	1.3
AIC	6259.98	6232.96	6234.56	6257.38	6262.68
BIC	6291.93	6277.69	6279.29	6302.11	6307.41

Note: Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 9: ESTIMATION RESULTS OF THE BASE MODEL FOR FIXED MATCHING PROTOCOL

	α=β=0	Sequence-Aligned	Strict Egalitarian	Liberal Egalitarian	Strictly Libertarian
λ_R	.16	.16	.15	.16	.16
	(.01)***	(.02)***	(.01)***	(.01)***	(.01)***
λ_M	.02	.02	.02	.02	.02
	(.00)***	(.00)***	(.00)***	(.00)***	(.00)***
α		.36	.08	.00	.00
		(.09)***	(.03)***	(.03)	(.01)
β		.36	.08	.00	.00
		(.10)***	(.16)	(.14)	(.14)
Observations	2280	2280	2280	2280	2280
LL	-1440.65	-1425.29	-1436.59	-1440.65	-1440.65
vs. α=β=0	0	31.24***	8.46**	0	0
AIC	2885.3	2858.06	2880.84	2889.3	2889.3
BIC	2896.764	2880.988	2903.768	2912.228	2912.228

Note: Standard errors are shown in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 10: ESTIMATION RESULTS OF THE MODEL WITH LEARNING FOR FIXED MATCHING PROTOCOL

	$\alpha=\beta=0$	Sequence-Aligned	Strict Egalitarian	Liberal Egalitarian	Strict Libertarian
θ_R	.06	.06	.05	.06	.06
	(.02)***	(.02)***	(.02)***	(.02)***	(.02)***
λ_R	.19	.20	.19	.19	.19
	(.02)***	(.01)**	(.02)***	(.02)***	(.02)***
θ_M	.01	.01	.01	.01	.01
	(.01)**	(.01)*	(.01)*	(.01)**	(.01)**
λ_M	.02	.02	.02	.02	.02
	(.00)***	(.00)***	(.00)***	(.00)***	(.00)***
δ	.74	.59	.74	.74	.74
	(.33)**	(.28)**	(.33)**	(.33)**	(.33)*
α	-	.39	.10	.01	.00
		(.09)***	(.03)***	(.03)	(.01)
β	-	.33	.08	.00	.00
		(.11)***	(.16)	(.13)	(.12)
Observations	2280	2280	2280	2280	2280
LL	-1428.75	-1412.72	-1421.99	-1428.73	-1428.75
vs. α=β=0	-	32.06***	13.52***	0.04	0
AIC	2867.5	2839.44	2857.98	2871.46	2871.5
BIC	2896.16	2879.564	2898.104	2911.584	2911.624

Note: Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

APPENDIX A

Solving Optimal Prices and Investment of the Standard Economic Model. Assume base line demand, *BD*, is given by $BD = a + I_M \cdot R_M + I_R \cdot R_R$, and market demand, *D*(*p*) is given by $D(p) = BD - b \cdot p$ with $b > 0$. Further assume that manufacturer's and retailer's profits are given by the sum of the residual endowment and the profit from product sale so that $\Pi_M = E - I_M + w \cdot D(p)$ and $\Pi_R = E - I_R + (p - w) \cdot D(p)$.

First the retailer maximizes its profit with respect to *p*, $\max_p \Pi_R = E - I_R + (p - w) \cdot D(p)$. From first order condition we get $p^*(w, I_M, I_R) = \dfrac{a + I_M \cdot R_M + I_R \cdot R_R + w}{2b}$. Given p^*, The manufacturer maximizes its profits with respect to *w*, $\max_w \Pi_M = E - I_M + w \cdot D(p^*)$. From first order condition, we then have $w^*(I_M, I_R) = \dfrac{a + I_M \cdot R_M + I_R \cdot R_R}{2b}$ and $p^*(I_M, I_R) = \dfrac{3(a + I_M \cdot R_M + I_R \cdot R_R)}{4b}$.

Substituting optimal prices into profits, the manufacturers' total profit is given by $\Pi_M(I_M, I_R) = E - I_M + \dfrac{(a + I_M \cdot R_M + I_R \cdot R_R)^2}{8b}$ and the retailers' total profit is given by $\Pi_R(I_M, I_R) = E - I_R + \dfrac{(a + I_M \cdot R_M + I_R \cdot R_R)^2}{16b}$.

Because the profit function is convex in investments, $D^2\begin{pmatrix} \Pi_M(I_M, I_R) \\ \Pi_R(I_M, I_R) \end{pmatrix} = \begin{bmatrix} R_M^2 & R_M \cdot R_R \\ R_M \cdot R_R & R_R^2 \end{bmatrix}$ is positive semidefinite, we will always have corner solutions to the maximization problem. Hence for *i*=*M*,*R*, either $I_i = 0$ or $I_i = E$ so that

$$(I_M^*, I_R^*) = \begin{cases} (0,0) & if \quad 0 < R_M < R_{M1} \quad and \quad 0 < R_R < R_{R1} \\ (0,E) & if \quad 0 < R_M < R_{M2} \quad and \quad R_R \geq R_{R1} \\ (E,0) & if \quad R_M \geq R_{M1} \quad and \quad 0 < R_R < R_{R2} \\ (E,E) & if \quad R_M \geq R_{M3} \quad and \quad R_R \geq R_{R3} \end{cases}.$$

We can compute the threshold values by comparing profits for different investment strategies. In order for (0, 0) to be an equilibrium, we must have $\Pi_M(0,0) > \Pi_M(E,0)$ and $\Pi_R(0,0) > \Pi_R(0,E)$. This leads to $\frac{a^2}{8b} + E > \frac{(a + E \cdot R_M)^2}{8b}$ and $\frac{a^2}{16b} + E > \frac{(a + E \cdot R_R)^2}{16b}$. Defining $R_{M1} = \frac{1}{E}(\sqrt{a^2 + 8bE} - a)$ and $R_{R1} = \frac{1}{E}(\sqrt{a^2 + 16bE} - a)$, it is easy to show that the conditions are equivalent to $0 < R_M < R_{M1}$ and $0 < R_R < R_{R1}$.

Similarly, for (*E*, *E*) to be an equilibrium, we have $\Pi_M(E,E) \geq \Pi_M(0,E)$ and $\Pi_R(E,E) \geq \Pi_R(E,0)$, which leads to

(A1) $$\frac{(a + E \cdot R_M + E \cdot R_R)^2}{8b} \geq \frac{(a + E \cdot R_R)^2}{8b} + E$$

and

(A2) $$\frac{(a + E \cdot R_M + E \cdot R_R)^2}{16b} \geq \frac{(a + E \cdot R_M)^2}{16b} - E.$$

Denote R_M by *x* and R_R by *y*, so equation A1 becomes $\Phi_M(x, y) = Ex^2 + 2x(a + Ey) - 8b \geq 0$ and equation A2 becomes $\Phi_R(x, y) = Ey^2 + 2y(a + Ex) - 16b \geq 0$.

For (0, *E*) to be an equilibrium, the conditions are $\Pi_M(0,E) > \Pi_M(E,E)$ and $\Pi_R(0,E) \geq \Pi_R(0,0)$, which implies that $\Phi_M < 0$ and $R_R \geq R_{R1}$. Similarly, the conditions for (*E*,0) to be an equilibrium are given by $\Phi_R < 0$ and $R_M \geq R_{M1}$.

Hence, to solve for R_{M2}, R_{R2}, R_{M3}, and R_{R3}, it is sufficient to solve $\Phi_M(R_{M2}, R_R) = 0$ for R_{M2}, $\Phi_R(R_M, R_{R2}) = 0$ for R_{R2}, and to simultaneously solve $\Phi_M(R_{M3}, R_{R3}) = 0$ and $\Phi_R(R_{M3}, R_{R3}) = 0$ for R_{M3} and R_{R3}.

Solving Optimal Prices of the Behavioral Model. Given the baseline demand $BD = a + I_M R_M + I_R R_R$, the manufacturer's profit is given by $\pi_M = w(BD - bp)$ and the retailers' utility is given by $U_R = \pi_R - \alpha \cdot \max\{\frac{\tau}{1-\tau}\pi_M - \pi_R, 0\} - \beta \cdot \max\{\pi_R - \frac{\tau}{1-\tau}\pi_M, 0\}$.

Because the utility function is not continuously differentiable, we need to distinguish between the cases in which the retailer experiences disadvantageous and advantageous inequity. The retailer experiences disadvantageous inequity when $\pi_R - \frac{\tau}{1-\tau}\pi_M \le 0$ or equivalently $p \le (1+\frac{\tau}{1-\tau})w$.

Hence, the retailer faces the following maximization problem

$$\max_p (p-w)(BD-bp) - \alpha\,[\frac{\tau}{1-\tau}w - (p-w)](BD-bp)$$

$$s.t.\ p \le (1+\frac{\tau}{1-\tau})w.$$

Similarly, the retailer experiences advantageous inequity when $\pi_R - \frac{\tau}{1-\tau}\pi_M \ge 0$ or equivalently $p \ge (1+\frac{\tau}{1-\tau})w$. Hence, the retailer faces the following maximization problem

$$\max_p (p-w)(BD-bp) - \beta\left[(p-w) - \frac{\tau}{1-\tau}w\right](BD-bp)$$

$$s.t.\ p \le (1+\frac{\tau}{1-\tau})w.$$

Following Cui, Raju and Zhang (2007), the optimal retail prices are given by

$$p^*(w, I_M, I_R) = \begin{cases} \dfrac{BD+w}{2b} - \dfrac{\beta w\frac{\tau}{1-\tau}}{2(1-\beta)} & if\ \ w \le w_2 \\ w + \dfrac{\tau}{1-\tau}w & if\ \ w_2 < w \le w_1 \\ \dfrac{BD+w}{2b} - \dfrac{\alpha w\frac{\tau}{1-\tau}}{2(1+\alpha)} & if\ \ w > w_1 \end{cases}$$

where $w_1 = \dfrac{a(1-\alpha)}{1+\alpha+(2+\alpha)\frac{\tau}{1-\tau}}$ and $w_2 = \dfrac{a(1-\beta)}{1-\beta-(2+\beta)\frac{\tau}{1-\tau}}$.

If the manufacturer chooses a price in the range $w \le w_2$, then the manufacturer's maximization problem is given by $\max_w w(BD-bp)$, $s.t.\ \ p = \dfrac{BD+w}{2} - \dfrac{\beta w\frac{\tau}{1-\tau}}{2(1-\beta)}$ and $w \le w_2$.

If the manufacturer chooses a price from the range $w_2 < w \le w_1$, then the manufacturer's maximization problem is given by $\max_w w(BD-bp)$, s.t. $p = w + \gamma \cdot w$, $w > w_2$, and $w \le w_1$.

If the manufacturer chooses a price in the range $w > w_I$, then the manufacturer's maximization problem is given by $\max_{w} w(BD - bp)$, *s.t.* $p = \frac{BD + w}{2b} - \frac{\alpha\gamma \cdot w}{2(1+\alpha)}$ and $w > w_1$.

The optimal wholesale prices can be solved accordingly and are given by

$$w^*(I_M, I_R) = \begin{cases} \overline{w}_I & if \quad 0 < \beta \le 1 - 3\tau \quad and \quad \alpha \ge \beta \\ \overline{w}_{III} & if \quad 1 - 3\tau < \beta \le 1 - \tau \quad and \quad \beta \le \alpha < \overline{\alpha} \\ w_2 & if \quad 1 - 3\tau < \beta \le 1 - \tau \quad and \quad \alpha \ge max\{\overline{\alpha}, \beta\} \\ \overline{w}_{III} & if \quad \beta = 1 - \tau \quad and \quad \beta \le \alpha < 2\tau - 1 \\ w_2 & if \quad \beta = 1 - \tau \quad and \quad \alpha \ge max\{2\tau - 1, \beta\} \\ \overline{w}_{III} & if \quad 1 - \tau < \beta < 1 \quad and \quad \beta \le \alpha < 2\tau - 1 \\ \overline{w}_{II} & if \quad 1 - \tau < \beta < 1 \quad and \quad \alpha \ge max\{2\tau - 1, \beta\} \end{cases}$$

where $\overline{w}_I = \frac{BD(1-\beta)}{2b(1 - \beta - \beta\frac{\tau}{1-\tau})}$, $\overline{w}_{II} = \frac{BD}{2b(1 + \frac{\tau}{1-\tau})}$, $\overline{w}_{III} = \frac{BD(1+\alpha)}{2b(1 + \alpha + \alpha\gamma)}$, and $\overline{\alpha} = \frac{(1-\beta-3\tau)^2 - 8\beta\tau^2}{8\tau^2 - (1-\beta-3\tau)^2}$.

APPENDIX B: INSTRUCTIONS

Instructions

You are about to participate in a decision-making experiment. By following these instructions you can earn a considerable amount of money which will be paid to you in cash before you leave today. Your earnings depend on your decisions as well as on the decisions of other participants. It is important that you do not look at the decisions of others, and that you do not talk, laugh, or make noises during the experiment. You will be warned if you violate this rule the first time. If you violate this rule twice, you will be asked to leave the room immediately and your cash earnings will be $0. The experiment is designed in a way that the anonymity of all the participants is protected.

In this experiment, there will be a total of 20 decision rounds. In each round, you will earn point earnings measured in pesos. The more pesos points you earn, the more cash earnings you make. The decision steps and how you earn pesos points in every round are described as follows:

In each round, you will be randomly matched with another person in the room. You will be acting as either a retailer or a manufacturer. The other person who is matched with you will be acting as a manufacturer if you are acting as a retailer, or will be acting as a retailer if you are acting as a manufacturer. You will act as a manufacturer in 10 out of the 20 rounds and will act as a retailer in the other 10 rounds. In each round, both you and the person you are matched with will make decisions in two phases – an investment phase and a pricing phase. In the investment phase, both the manufacturer and the retailer will each be assigned with 10 pesos and they decide how much to invest to increase the base demand of the product that the retailer is buying from the manufacturer and selling to consumers. In the pricing phase, the manufacturer will decide on the wholesale price and the retailer will decide on the retail price of the product. Consumer demands, the manufacturer's profit, and the retailer's profit will be determined as described below. A manufacturer will not meet with the same retailer for more than once, and a retailer will not meet with the same manufacturer for more than once.

Experimental Procedure

The following procedural steps will be repeated in each of the 20 decision rounds:

Step 1: Determining your role

Your computer screen will show whether you are a manufacturer or a retailer in each round.

Every subject will be a retailer for 10 rounds and a manufacturer for the other 10 rounds.

Step 2: Determining each member's investment amount

At the beginning of each round both the manufacturer and the retailer will each start with 10 pesos. You will decide how much of the 10 pesos to invest. You can choose to invest 0 pesos, 5 pesos or 10 pesos. After both the manufacturer and retailer decide on their investments, their investment amounts will be shown to each other. Each investment is going to affect the total demand for the product in the way below.

Step 3: Determination of total demand

After both the manufacturer and retailer make investments (denoted as IM for manufacturer and IR for retailer in pesos), the total demand D in unit is determined as follows.

$D = 1 + 0.2*\text{IM} + 0.2*\text{IR} - P$

That is, whenever you make an investment, the investment is going to increase the base demand of the product by 0.2 times of your investments if you are acting as the manufacturer or by 0.2 times of your investments if you are acting as the retailer. Here P refers to the retail price that will be chosen by the retailer later.

Step 4: Manufacturer decides on wholesale price W

After investment amounts IM and IR are chosen, the manufacturer decides on wholesale price *W* at which the manufacturer sells the product to the retailer.

Step 5: Retailer decides on retail price P

After the wholesale price *W* is set by the manufacturer, the retailer decides on retail price *P*.

Step 6: Profits to the manufacturer and retailer

After the manufacturer chooses wholesale price *W* and the retailer decides on the retail price *P*, the manufacturer's total profit PiM is given by:

$$\text{PiM} = 10 - \text{IM} + W * D$$

The retailer's total profit PiR is given by:

$$\text{PiR} = 10 - \text{IR} + (P - W) * D$$

Here *D* is the demand, 10 is the amount of pesos you start with, and IM or IR is the investment amount you made before.

You will play a test game of 2 rounds before the formal game starts.

Example

Suppose the manufacturer invests 5 pesos and the retailer invests 5 pesos. The manufacturer charges a wholesale price of 1.5 pesos and the retailer charges a retail price of 2.25 pesos. Then total demand *D* is going to be given by

$D = 1+ 0.2*5+ 0.2*5 – 2.25 = 0.75$

$\text{PiM} = 10 - \text{IM} + W * D = 10 – 5 + 1.5*0.75 = 6.125$

$\text{PiR} =10 - \text{IR} + (P - W) * D = 10 – 5 + (2.25 – 1.5)* 0.75= 5.5625$

Your Payoffs

Your dollar earnings for the experiment are determined as follows. First, we will sum up your pesos earnings for each of the 20 rounds in which you participated. The profit is going to be converted at a fix rate of dollars per pesos. On top of these earnings you will get a $5 participation fee. We will pay you this amount when you leave the experiment. Note the more pesos you earn, the more money you will receive.