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The role of fairness in competitive supply chain relationships: An experimental study

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ABSTRACT

This paper examines whether the conclusions of standard supply-chain models carry over to repeated supply-chain relationships. The past models assume profit-maximizing agents in one-shot games. In these games, an essential unresolved issue concerns which parties in the supply chain have greater power to extract a larger share of supply chain profit: the manufacturer or the retailer. In particular, we consider a two-manufacturer/one-retailer supply chain over repeated periods of interaction. We find that the experimental results are closest to a symmetric outcomes hypothesis: the supply chain members tend to choose similar margin levels and profits tend to be more fairly divided than non-cooperative, game-theoretic, supply-chain models predict. Individual supply chain member's behavior shows evidence of fairness concerns for supply chain members. These results indicate the significant role of fairness in competitive supply chain relationships, even in a scenario that is designed to favor one supply chain member over the others.

1. Introduction

With the evolution of distribution methods in recent decades, practitioners and academics are studying supply chain relationships assuming various theoretical forms of channel power relations. For example, following a standard structure, supply chain contracting models assume leader–follower behavior with the supplier acting as leader and the retailer as follower (e.g., Aust & Buscher, 2012; Chen et al., 2012; Choi, 1991; Coughlan, 1985; He, Prasad, & Sethi, 2009; Hsieh, Wu, & Huang, 2008; Huang & Li, 2001; Lau, Lau, & Zhou, 2006; Lee & Staelin, 1997; McGuire & Staelin, 1983; Spengler, 1950; Yao & Liu, 2005). An alternate form of leader–follower relationship involves the retailer playing the role of leader (e.g., Aust & Buscher, 2012; Choi, 1991; Lau et al., 2006; Lee & Staelin, 1997); this formulation reflects the growing belief among practitioners that retailers are gaining power in the supply chain. In addition, several papers have considered a more symmetrical relationship between suppliers and retailers (e.g., Aust & Buscher, 2012; Choi, 1991; Huang & Li, 2001; Jeuland & Shugan, 1983; Lau et al., 2006; Lee & Staelin, 1997; Yao & Liu, 2005). An essential unresolved issue concerns which parties in the supply chain have greater power to extract a larger share of supply chain profit: the manufacturer or the retailer. All these models, however, have limitations as to how adequately they can capture channel power relations.

The above models of supply channel relationships assume two things: (1) they are one-shot games (some involving a sequence of two stages played once) and (2) supply chain members' behavior is entirely profit-maximizing. In this paper, we study a supply chain experiment that considers empirical challenges to these two assumptions.

A challenge to the first assumption is that the models (Manufacturer Stackelberg Leadership, Retailer Stackelberg Leadership, Vertical Nash, Collusion, etc.) generally are intended to describe business situations that involve repeated interactions in real applications. In such repeated contexts, it is natural to allow competitive dynamics to come into play – particularly since the actions taken in the previous period provide a natural focal or reference point that may anchor and influence subsequent play. Such competitive dynamics can induce a player to strategically cooperate with rivals in repeated interactions (e.g., Dreber, Fudenberg, & Rand, 2014; Fischbacher, Gächter, & Quercia, 2012; Sonnemans, Schram, & Offerman, 1999) or to behave in what amounts to a cooperative fashion when they take into consideration future interactions (Reuben & Suetens, 2012).

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A challenge to the second assumption is that players interacting over time may also come to consider their own outcomes in relation to the outcomes of the other players. In particular, an important related behavioral theory with dynamic (as well as static) implications arises from considerations of perceptions of fairness in previous periods (Fehr & Schmidt, 1999; Kahneman, Knetsch, & Thaler, 1986; Rabin, 1993). In fact, cross-sectional survey research in the past three decades has shown that fairness considerations among channel members play a significant role in channel relationships (e.g., Anderson & Weitz, 1992; Frazier, 1983; Heide & John, 1988; Kumar, 1996; Kumar, Scheer, & Steenkamp, 1995; Li, Karande, & Zhou, 2009), though it is unknown the extent to which fairness concerns influence channel power relations. Furthermore, the experimental economics literature has challenged the equilibrium predictions that assume profit-maximization behavior by showing extensive evidence on the importance of fairness in explaining negotiations behavior. Until recently, however, economics-based theoretical research on supply chain relationships has mostly disregarded fairness as a factor. A notable exception consists of Cui, Raju, and Zhang (2007), who consider the implications of incorporating fairness into supply chain research in a simple single-manufacturer/single-retailer dyad. Caliskan-Demirag, Chen, and Li (2010) extend the results of Cui et al. (2007) to nonlinear demand functions. And recently, Du, Nie, Chu, and Yu (2014) incorporate supply chain member's preferences of reciprocity into a dyadic channel.

Only a few studies, however, have examined the role of fairness in an experimental context by investigating the extent to which fairness model specifications describe supply chain members' behavior. Loch and Wu (2008), for example, study the role of social preferences in the context of repeated interactions between one supplier and one retailer and find that supply chain members consistently deviate from profit maximizing behavior, which suggests cooperation between members over time. Ho and Su (2009) and Ho, Su, and Wu (2014) examine peer-induced fairness concerns and distributional fairness concerns in the one-supplier/two-retailer setting. However, no study has examined the impact of fairness in supply chain relationships in the presence of competition between suppliers. We accordingly study the applicability of profit-maximizing predictions, as compared to competing models, when there are repeated interactions in the context of two suppliers and one retailer.

The current paper complements previous experimental oligopoly game literature by examining the implications of fairness among supply chain participants with repeated interactions. This builds on past work that examines simultaneous and sequential quantity and price competition, dynamics and convergence in oligopolistic markets, and collusion (summarized effectively in an extensive overview of recent oligopoly experiments by Potters & Suetens, 2013). This past work includes the role of repeated interaction in quantity and price competition (e.g., Brandts & Guillen, 2007), game dynamics (e.g., Davis, 2011; Huck, Normann, & Oechssler, 2002), and tacit collusion (e.g., Bruttel, 2009; Hampton & Sherstyuk, 2012), but it does not consider fairness.

Overall, the intended contribution of the current paper is to add to the empirical work on supply chain relationships by providing laboratory experiments designed to examine (1) the dynamic behavior in a repeated interaction context in the presence of competition at the supplier level and (2) the applicability of profit-maximizing predictions of supply chain contracting games as compared to fairness models. In our experiments, we particularly consider the supply chain structure considered by Choi (1991) involving two manufactures selling through a common retailer.

2. Models of supply chain relationships and fairness

We begin by reviewing the one-shot game supply-chain model of Choi (1991) in which two manufacturers sell through a common retailer. In this context, we also introduce a formulation of fairness theory suggested by Fehr and Schmidt (1999).

2.1. A common retailer supply chain model

Following Choi (1991), the two-manufacturer/one-retailer model can be described as follows. Suppose there are downward sloping demand functions:

$$q_i = a - bp_i + \gamma p_j, \quad i, j = 1, 2, \quad i \neq j, \quad a > 0, \quad b > \gamma > 0, \quad (1)$$

where q_i is the demand for brand i at retail price p_i (given that the retail price of the other brand j is p_j) and γ describes the degree of substitutability between the two products (Choi, 1991; Ingene & Parry, 1995; Jeuland & Shugan, 1988; McGuire & Staelin, 1983). When $\gamma = 0$, the model represents two (independent) single-manufacturer/single-retailer bilateral monopoly channels. It is also assumed that the own-price effect exceeds the cross-price effect (so that $b > \gamma$).

The profit functions for manufacturer 1, manufacturer 2, and the retailer, respectively, are

$$\Pi_{M_1} = \left(w_1 - c_{m_1}\right)q_1, \Pi_{M_2} = \left(w_2 - c_{m_2}\right)q_2, \text{ and } \Pi_R = \sum_{i=1}^{2} (m_i - c_{r_i})q_i \equiv \sum_{i=1}^{2} \Pi_{R_i}; \quad (2)$$

where w_i is manufacturer i's wholesale price, m_i is the retail margin on product i (where $m_i \equiv p_i - w_i$, the retail price less the wholesale price), c_{m_i} is manufacturer i's variable cost of producing its product, and $c_{r_i}$is the retailer's handling cost for product i. In this notation, Π_{R_i} represents the retailer's profit from product i and Π_{M_i} represents manufacturer i's profit (manufacturer i is the producer of product i). Equilibrium wholesale prices and retail margins (w_1, w_2, m_1, and m_2) for a single-period game are calculated by maximizing the three profit functions in Eq. (2).

A different sequence of optimization calculations is used to compute three of the competing profit-maximizing equilibrium predictions (see Choi, 1991). Manufacturer Stackelberg leadership involves the manufacturers simultaneously choosing w_1 and w_2 in Stage 1 and the retailer choosing m_1 and m_2 in Stage 2. Retailer Stackelberg leadership involves the retailer choosing m_1 and m_2 in Stage 1 and the manufacturers choosing w_1 and w_2 in Stage 2. The Vertical Nash game involves the manufacturers and retailer all simultaneously setting w_1, w_2, m_1, and m_2 in a single stage.

Fig. 1, for the simplifying case of no cross-price effects ($\gamma = 0$), describes the possible equilibrium concepts for a single-period game, such as Manufacturer Stackelberg (MS), Retail Stackelberg (RS), and Vertical Nash (VN). The equilibrium outcomes for these three single-period games provide a starting point for describing what can happen in alternate contexts, including multi-period, repeated games.

In the left-hand panel of Fig. 1, the VN equilibrium lies at the intersection of the reaction functions (first-order conditions) of one manufacturer and the retailer. The MS equilibrium lies at the point on the retailer's reaction function that provides the highest manufacturer profit (similarly, the RS equilibrium lies at the point on the manufacturer's reaction function that provides the highest retailer profit).

The right-hand panel of Fig. 1 depicts the retail and manufacturer profits for the MS, RS, and VN cases. The retailer profit is typically greatest under RS and lowest under MS, and manufacturer profit is the reverse. Consequently, each supply chain member has