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Generous, spiteful, or profit maximizing suppliers in the wholesale price contract: A behavioral study

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ABSTRACT

Prior experimental research shows that, in aggregate, decision makers acting as suppliers to a newsvendor do not set the wholesale price to maximize supplier profits. However, these deviations from optimal have rarely been examined at an individual level. In this study, presented with scenarios that differ in terms of how profit is shared between retailer and supplier, suppliers set wholesale price contracts which deviate from profit-maximization in ways that are either generous or spiteful. On an individual basis, these deviations were found to be consistent with how the profit-maximizing contract compares to the subject's idea of a fair contract. Suppliers moved nearer to self-reported ideal allocations when they indicated a high degree of concern for fairness, consistent with previously proposed fairness models, and were found to be more likely to act upon generous inclinations than spiteful ones.

1. Introduction and literature review

Pure profit maximization is often assumed to motivate operational decision making, but community and social pressures also guide individual decision makers (Gorman & Kehr, 1992; Kahneman, Knetsch, & Thaler, 1986). For example, in the "fair-trade" movement, relatively powerful retailers pay higher prices for comparable order quantities in order to more fairly allocate supply chain profits to their relatively vulnerable suppliers (Moore, 2004). Managerially, it is crucial to identify the underlying causes that would influence a decision-maker towards or away from maximum profits. A growing body of research has attempted to model individual social preferences in objective functions. (Bolton, 1991; Bolton & Ockenfels, 2000; Charness & Rabin, 2002; Cui, Raju, & Zhang, 2007; Demirag, Chen, & Li, 2010; Fehr & Schmidt, 1999; Katok, Olsen, & Pavlov, 2014; Rabin, 1993; Wu & Niederhoff, 2014). Our paper attempts to show to what extent and in what direction an individual's concept of fairness will guide deviations from profit-maximization.

But why consider fairness? Alternative utility functions and experimental work have considered risk-averse newsvendors (e.g., Eeckhoudt, Gollier, & Schlesinger, 1995; Schweitzer & Cachon, 2000) and newsvendors with reference-dependent preferences regarding stock outs and leftovers (e.g., Ho, Lim, & Cui, 2008). The newsvendor's supplier, though, faces no demand risk; and reference-dependent utility with loss-aversion cannot explain generous supplier behavior where less profit and lower allocations are intentionally chosen over higher profits or higher allocations (Koszegi & Rabin, 2006). Wu and Niederhoff (2014) address the impact of individual fairness concerns in a traditional newsvendor setting. They show analytically that suppliers may over- or under-price relative to the profit-maximizing optimal wholesale price, w^*, if the allocations achieved at w^* do not match the decision maker's ex-ante preference for profit allocations. The degree and direction to which they respond to this discrepancy—if at all—depends on the weight that the decision maker assigns to fairness concerns. They find that the supplier's fairness preferences have a stronger overall effect on the supply chain's performance than the retailer's, supporting the idea that maintaining fairness in a distribution channel "should be the supplier's first concern" (McCarthy, 1985, p. 33).

Based on the importance of the supplier, this behavioral paper further probes this fairness preference model – this time primarily from a supplier's decision perspective. In order to isolate the effects of individual fairness concerns on suppliers, our work differs from existing research in three primary ways: (i) we focus on the supplier facing a retailer with known order quantities, (ii) we pre-measure subjects and correlate individual preferences to individual results across the population, allowing maximum heterogeneity to be explored, and (iii) we automate the decisions of the human retailers in our study so there is no private information or risk of

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rejection. Human subjects play the role of retailers in order to motivate human-to-human fairness motivations. However, the actual decisions of the retailer subjects (order quantity) are automated to ensure consistency and remove uncertainty for the subjects acting as suppliers.

Prior experimental work in supplier price-setting has focused largely on deterministic price-sensitive demand and has analyzed the behavior based on observed results (Katok & Pavlov, 2013; Katok et al., 2014). These studies show that subjects do deviate from profit-maximization. Using a maximum likelihood estimate, Katok et al. (2014) estimate a homogenous parameter of ideal allocations (identical for all suppliers and retailers) and then use observed decisions relative to this fairness point to calculate individual disutility parameters for the retailer. Our paper builds on these studies by considering two primary suspects for sub-optimal deviation: calculation error and fairness preferences. Further, our experimental design allows for full heterogeneity of both ideal allocation and disutility weights. Individual deviations in decision making are used to test analytical models of fairness-based utility maximization. By studying personal-level biases, this paper approaches the questions of bias from the perspective of individual utility functions and analyzes the decisions relative to these measures. This focus on individual behavior through pre-and post-experimental tests about individual preferences and intentions is unique to our paper.

Additionally, prior studies (Katok & Pavlov, 2013; Katok et al., 2014) have either implied or explicitly included privately-held information about the partner's fairness motivations. As a result, a subject's decisions are as much a function of his own preferences as his beliefs about his partner's decisions. A subject with no concerns for fairness himself may deviate due to beliefs that his partner will react based on fairness or other concerns. To isolate the supplier's motivation, in this study the retailer response is known by the supplier to be automated. The supplier's task is to set a price given the retailer's response curve which includes the resulting order quantity, expected sales, and expected profits for both parties. The retailer response curve is provided directly to the decision maker, to reduce computational burden for the subjects and allow more control over treatment conditions.

Methodologically, the closest paper to ours is that of Moritz, Hill, and Donohue (2013) who look at pre-measured problem solving skills in the newsvendor problem to study how individual heterogeneity in pre-measured analytical skills relates to observed order quantity of newsvendors. We apply a similar individual focus on the price-setting supplier under the analysis of fairness concerns. To our knowledge we are the first to incorporate individual measurements of ideal fairness allocations separately from degree of concern for fairness; and then test the contract decisions against the commonly used fairness utility function.

We have chosen the newsvendor model under wholesale pricing for two main reasons: its pervasive application in practice and its structure which provides no intrinsic motivation to reduce supplier profits through either generosity, spite, or risk-aversion. Other work in supply chain coordination and pricing focuses on more sophisticated contracting models, such as the two-part or three-part tariff (Ho & Zhang, 2008; Lim & Ho, 2007), as well as revenue sharing and buy-back contracts (Katok & Wu, 2009; Niederhoff & Kouvelis, 2014). However, the ubiquitous nature of the wholesale price contract in practice makes it an important contract to understand, both in its predicted implementation and in the cause of deviations from optimal results. Further, its structure reduces the possible external motivations for deviation (through either generosity, spite, or risk-aversion) compared to the risk-sharing coordinating contracts, and thus is a natural starting point for studying individual motivations. Without demand risk, the supplier's decision is much like a dictator game; a well-studied construct in experimental economics and game theory (cf. Camerer, 2003, pp. 43–100). The supplier calculates the retailer's optimal order quantity given the distribution of demand and then makes a take-it-or-leave-it offer to the retailer in the form of a unit price (Lariviere & Porteus, 2001). The important distinction is that the supplier's profits are concave in wholesale price and are maximized at a price which yields positive profit to the retailer. The retailer's optimal order quantity and the expected profits of both the retailer and the system are monotonically decreasing in wholesale price. Due to the supplier's concave profit function, deviations from the supplier's profit-maximizing contract will always hurt the supplier's payoff, making generosity or spite a costly social preference to enact. The ability to both help and hurt in a dictator setting has been explored by Bardsley (2008), List (2007), and Krupka and Weber (2013). These show that the frequency of giving, neutral, or taking decisions are consistent with a utility function that incorporates social acceptability of an action. From this, one would expect to see almost no hurtful deviations from profit maximization (which hurt both parties) and very few generous deviations (which help the retailer at the supplier's loss).

The major goal of this paper is to analyze supplier decisions in setting a price to a newsvendor at an individual level. Based upon prior studies, only a subset will choose to maximize profits. This paper explores the direction and magnitude of deviations from profit-maximizing behavior – both errors and intentional – and compares the observed behavior to the predictions of fairness-based utility maximization models to better understand the part that fairness plays in the decision making process. The wholesale contract is predicted to be inefficient due to double-marginalization (Lariviere & Porteus, 2001; Spengler, 1950); this paper studies if and when those inefficiencies occur within individual decision-maker profiles.

2. Model and hypotheses

Based on traditional fairness-minded utility functions and their role in the newsvendor problem (Bolton, 1991; Cui et al., 2007; Fehr & Schmidt, 1999; Katok et al. 2014; Wu & Niederhoff, 2014), the utility-maximizing result for fairness depends on two factors: the degree of concern a subject has for achieving fairness and the subject's ideal allocation. This ideal allocation is sometimes modeled using a scale factor, k,[1] which identifies the ideal scaling of profits such that $\pi_S = k\pi_R$, or equivalently, that the retailer earns allocation $\pi_R/(\pi_S + \pi_R) = 1/(1+k)$ (Cui et al., 2007; Katok et al., 2014). Alternatively, Wu and Niederhoff (2014) use a percentage allocation, $\gamma = \pi_R/(\pi_S + \pi_R)$, to indicate the ideal fairness allocation to the other player, leaving $(1-\gamma)$ to the supplier. Our paper elicits preferences as in Wu and Niederhoff (2014), using the percentage allocation to the supplier, denoted as *Fair Allocation Ideal Reference (FAIR)*. All results are the same as the classic model using $k = FAIR/(1-FAIR)$.

The degree of concern the subject has for fairness is represented with disutility weights within the utility function. Traditionally, utility is modeled as a piecewise function with advantageous disutility (β) and disadvantageous disutility (α) associated with the magnitude of unfair allocations. It is important to note that the standard assumption gives $0 \leq \beta \leq \alpha$; i.e., a decision maker is more strongly influenced by disadvantageous inequality than by advantageous inequality (De Bruyn & Bolton, 2008; Fehr & Schmidt, 1999). Wu and Niederhoff (2014) use algebra to re-write the utility function as a piecewise function with spiteful (A_s) and generous (A_g) disutility weights, $A_s \leq 0 \leq A_g$. These weights are a

[1] Note that the supplier model in Cui et al. (2007) uses γ for the supplier's scale factor and k for the retailer's scale factor. To avoid confusion with Wu and Niederhoff's (2014) use of γ as the allocation percentage, we use k here to denote the supplier's scaler.