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Consignment or wholesale: Retailer and supplier preferences and incentives for compromise ☆

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ABSTRACT

We consider two independently managed parties, a retailer and a supplier, that are considering either a wholesale or a consignment contract to produce and market a single good. Both parties have an interest in reaching an agreement, but their first choice of contract type are generally not the same. We define the strength of retailer and supplier preferences for their respective choices of contract type as the ratio of their expected profits for their first choice of contract type over that for the alternative contract type. We study how uncontrollable factors as well as controllable factors affect the strength of retailer and supplier contract preferences. We develop incentive payments that can potentially be used to increase the likelihood of success in negotiating an agreement.

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1. Introduction

In a traditional supply chain where products are sold under wholesale, an upstream entity (supplier) sells a product to a downstream party (retailer) who in turn serves market demand. The retailer owns and controls the inventory and thus incurs the cost of stocking excess inventory to meet demand that exceeds expected demand and/or incurs stock-out costs when demand exceeds supply. Alternatively, under a consignment contract, the supplier maintains ownership and control of inventory, determining the stocking level and product pricing. The retailer is paid a fee marketing the product and handling sales transactions. Thus purely from the standpoint of inventory risk, the supplier will generally prefer a wholesale contract while the retailer will prefer consignment.

We examine supplier and retailer preferences for contract types and associated profits, focusing on the two most popular contract types, consignment and wholesale, and examine how they are influenced by both uncontrollable and controllable variables. Uncontrollable variables pertain to exogenous market factors such as market price elasticity and demand uncertainty. Different values of these uncontrollable variables create different market settings in which the supplier and retailer contract preference levels and profit expectations vary. Controllable variables are decision variables that affect the retailer's and supplier's profit. Examples include price markup, and how the total unit cost of bringing the product to the market is shared by the retailer and the supplier.

Consignment, as described in Hackett [14], is a unique contract where the retailer, over a given period, takes possession of the goods owned by the seller (supplier), promotes the sale of these goods to buyers, and receives a share of the sales revenue (sales commission). The supplier owns the goods until they are sold. For example, books (e.g. school textbooks and novels), canned goods (Campbell soup), beverages (beer) are frequently sold on consignment. More typical supplier-retailer arrangements involve wholesale contracts where an upstream entity (supplier) sells a product to a downstream party (retailer) who in turn serves market demand. Some Internet-based retailers utilize both consignment and wholesale. For example, Amazon.com not only buys a broad range of products on wholesale and sells them to customers worldwide, but also sells selected products of third party sellers (e.g. Officemax) on consignment. We also note that under certain circumstances, such as with buyback provisions, wholesale can be nearly equivalent to consignment in how profits are divided between the retailer and supplier [17].

Profit considerations aside, it is reasonable to find that the retailer has a preference for consignment over wholesale because with consignment he is freed from administrative work such as setting product prices and determining inventory levels. For the same reasons, the supplier may show a preference for a wholesale arrangement. However, as will be demonstrated in this study, with profit considerations, the relative strength of the retailer and supplier preferences for consignment and wholesale can vary widely with different market settings.

For either type of contract we consider *the retailer per as the primary mover* (Stackelberg leader) who offers, to the supplier,

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a take-it-or-leave-it contract that specifies parameters that lead to his profit for making a sale. In a consignment contract, the retailer specifies a revenue share for each unit sold. Based on these terms, the supplier decides on a market price and stocking quantity. For example, when goods are sold on consignment at Amazon.com, the retailer collects a fixed fee (currently $0.99) plus a "referral fee" that depends on the item's category, e.g., computers (6%), camera and photo and electronics items (8%), shoes (15%), jewelry (20%). (For more information, see Amazon.com). In consignment, it is the supplier's responsibility for setting the retail price and stocking quantity. For the wholesale case, the retailer specifies a price markup that converts a supplier-determined wholesale price to a market price. The supplier then sets a wholesale price, and finally the retailer determines a stocking quantity. The markup is either an Additive Price Markup (APM)[1] where the retail price is the retailer's unit cost plus profit or a Multiplicative Price Markup (MPM) where the profit per unit is a stipulated fraction of the retailer's unit cost. By specifying the markup in advance of negotiation, the retailer has the opportunity to strategically pre-commit to a pricing policy in order to influence the supplier's action.[2] This is in contrast to more traditional wholesale agreements where the Stackelberg leader is the manufacturer who pre-commits to a wholesale pricing policy or stocking policy in order to influence the retailer's decisions (e.g. see [5,19,33]).

We do not address in this paper the issue of determining whether the supplier should accept or reject the contract offer. Instead we aim to show how changes in market settings and controllable parameters can affect the retailer and supplier profits and preferences. Achieving this goal is important for the following reason. Consider two independently managed parties, a retailer and a supplier, that convene to negotiate a retail contract agreement. When parties neglect to address their differences in contract preferences and profit expectations, the negotiation can lead to a suboptimal contract or even failure to reach any final agreement as has been demonstrated by this next study. A Duke Today [4] report in 2007 highlighted two university professors' negotiation experiment involving 266 MBA students playing roles of parts sellers and buyers. Results of this experiment reveal that each side underestimated how much the other was willing to bend, with the result that each party reckoned it got the better end of the negotiation. In offering an incentive to try closing an agreement, the buyers thought they had hit the sellers' bottom figure, when in fact they overpaid by a wide margin. Thus, a thorough assessment of contracting parties' preferences and profit expectations from different contracts can help minimize offering over-sweetened incentives which can potentially hurt profits of both parties.

In this paper, we propose to measure the strength of retailer's preference for consignment via ρ_R, defined to be the retailer's expected profit under consignment divided by the retailer's expected profit under wholesale. Similarly, we measure the supplier preference for wholesale by ρ_S, the ratio of her expected profit under wholesale to her expected profit under consignment. A ratio of one reflects indifference between wholesale and consignment whereas a value of $\rho_R(\rho_S)$ much larger than one indicates a strong preference by the retailer (supplier) for a consignment (wholesale) contract.

Although ρ_R and ρ_S measure relative preferences for contract type, they do not lead to specific details that would be necessary to have for contract negotiation between retailer and supplier. We also present an alternative measurement which is based on the value of a side payment from the retailer to the supplier that if made could result in a consignment contract with expected supplier profit equivalent to that of a wholesale contract. We study the properties of this side payment as well as the post-payment additional profit that the retailer enjoys via a consignment contract as opposed to a wholesale contract. We also explore, via associated market prices and stocking quantities, the impact that choice of contract type has on consumers of the product.

Our contributions are as follows. First, this study is first to evaluate the relative gains/losses realized by the contracting parties associated with consignment versus wholesale contracts utilizing a multiplicative demand (MD) model, i.e. a stochastic iso-price-elastic demand function. We develop metrics, e.g. preference ratios and relative gain ratios, that are useful to both the retailer and supplier in assessing their attraction to one contract type versus the other. We also develop side-payments that might be used to obtain an agreement on the type of contract acceptable by both parties.

Secondly, we develop models that optimize the supplier and retailer expected profits for the additive demand (AD) case. Results in the existing literature on this case are limited because of the technical difficulty in developing analytical solutions to models with additive demand. But under certain simplifying assumptions, we show that the retailer and supplier price and stocking problems can be formulated as bi-level (two-stage) nonlinear programming models. Utilizing an off-the-shelf nonlinear optimization package, we optimized a wide range of problems and then analyzed their solutions for effects of controllable and non-controllable factors on the supplier's and retailer's decisions for the consignment and wholesale cases. Our interest in solving these problems is to see if the analytically-derived results for the multiplicative case carry over to the additive demand case. Based on our computational work, it appears that most of the major results do carry over.

Third, to the best of our knowledge the additive price markup results we report in this paper are new. The results of this work can be used in developing incentives that may improve the alignment of the retailer's and supplier's decisions. Some potential rewards from offering the right incentives are a smoother negotiation process and an increased likelihood of reaching an agreement.

Our results support the conclusion that when the demand function is MD, the effect of price elasticity (defined as β) on contract preferences and profit expectations depends on the type of price markup. Specifically for MD with APM, an elevated price elasticity lowers both the retailer's and supplier's preference levels, while with MPM an elevated price elasticity raises both preference levels. Although the main focus of our paper is on the relative profits of the retailer and supplier under different contract types, our analysis has implications for consumers. When β is large (consumers are very price sensitive) we found that under APM, market price is larger under the wholesale contract arrangement versus consignment, while for small β the opposite is true. Again for APM and for *all* values of β, the service level provided by the consignment optimal stocking quantity is higher than that provided by the wholesale contract. Thus when β is large, consumers are better off if the supply chain operates with a consignment arrangement.

In addition, we found that for MD and both markup policies, an increase in the retailer cost share α results in an increase in the retailer (supplier) preference levels for consignment (wholesale). Given that our analysis was restricted to the case where demand uncertainty is uniformly distributed, we found that retailer and supplier preference levels are independent of demand uncertainty as reflected via the support of ε. This is true for both APM and MPM. Through our computational work on the additive demand (AD) case we found that similar to MD, under APM, both ρ_R and ρ_S increase in α but decrease in β. For MPM, both preference ratios increase in α, but ρ_R increases in β while ρ_S decreases in β. Unlike the MD case, we found that these ratios depend upon demand uncertainty.

The remainder of this paper is organized as follows. In Section 2, we review the relevant literature and highlight our contributions.

[1] A 1984 survey of Fortune 500 companies shows that 45% of all companies use APM (see [29]).

[2] This assumption is drawn from [33].