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Retailer's response to special sales: price discount vs. trade credit

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Abstract

Given the increasing saliency of special offers as a sales promotion tool, this paper analyses the advantages and disadvantages of the two most common payment reduction schemes, namely a decrease in the purchase price and a delay in the payment of the merchandise. Following some of the latest empirical evidence in the sales promotion field, the model includes a price-dependent demand, where price incorporates the ability of the retailer to pass on some of the savings to the customers. The integration of both the purchasing and the sale implications of the vendor's offer on the retailer's profit forms an integral part of the model. A numerical example highlights the main features of the model. © 2001 Elsevier Science Ltd. All rights reserved.

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1. Introduction

The practice of vendors offering special incentives to retailers for a limited time period to offload excess inventory is quite prevalent in some industries today [1,2]. In fact, these practices are even beginning to take precedence over advertising in the sales promotion budget of many firms [3,4] in spite of the on-going controversies over their profitability [5–8]. Quite a few examples of these practices have been documented in the literature for several sectors of the economy e.g. [9–11,1], including pharmaceuticals, hardware, furniture, fashion apparel, and frozen food. These vendor-to-retailer incentives, denoted by trade promotions in the sales-promotion literature [3], can take on many forms, with discounts on the purchase price (DPP) and a delay of payment (DOP) being the most prevalent. It is the purpose of this paper to develop the retailer's profit maximizing strategy in answer to these promotions. By their very nature, these incentives will impact on the retailer's cost and revenue structures. On the cost side, these effects are manifested through modifications in both the ordering and the inventory policies, as the retailer places a special order from the vendor in response to the trade promotion under consideration. In turn, the resulting cost decreases leave open the possibility for the retailer to design its own retail promotion, by reducing the price it charges to its own customers for the merchandise, with the corresponding expected rise in the demand for the merchandise and hence on the resulting sales revenues. As a result, the paper models the retailer's decision process through the design of the profit-maximizing ordering and retail promotion strategies in response to the vendor's trade promotion. The integration of both the purchasing and the sale implications of the vendor's offer on the retailer's profit forms an integral part of the model.

There exists an extensive literature both in operations management and in marketing, concerning the retailer's strategic decision, when confronted with a DPP special

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sale. On the operations management side, the basic formulation of Baker [12] appears in many textbooks on the subject, such as in Tersine [13]. Many other studies have attempted to adapt Baker's model [12] to handle model concerns. Examples of this work include Ardalan [14], to incorporate discount periods not coinciding with the replenishment cycle and Arcelus and Srinivasan [15], to consider cases where the retailer's special purchase is large enough to encompass several no-discount ordering cycles. Most of this extensive operations management literature has been reviewed elsewhere [16,17]. A common assumption of the majority of these studies is that of a constant demand, independent of sales-price fluctuations. Hence, the buyer/retailer's ability to influence demand by passing on at least some of the discount to its customers has been ignored, with the exceptions of those studies [18,16,19] which incorporate the price/demand relation. An important contribution of Ardalan [19] is to show that the usual formulation of the constant demand case, designed to decide whether the special offer should be accepted or rejected, is no longer relevant when the demand is price dependent, since the acceptance option is always dominant. However, the models use the limited strategy of passing on the entire discount on all the units bought in the special sale, even though the marketing evidence clearly indicates e.g. [20–23,3] that this is not necessarily the case.

With respect to the shape of the demand function, the operations management literature favours the linear demand, as a convenient two-term Taylor approximation to the more complex and more theoretically appealing exponential counterpart [24], with its constant price elasticity of demand. The marketing literature has gone much further in the characterization of DPP behaviour, specially as it refers to the implications of the functional demand form, be it linear or non-linear, on channel behaviour e.g. [6,8,22,23,25]. Nevertheless, it is also common practice e.g. [4], for wholesalers to resort to the alternate strategy of allowing credit, instead of discount, to induce larger orders, especially when the fear of competitive reaction to a DPP policy is high [26–29]. However, the fact that a DOP policy conveys a new benefit to the retailer, for whom it may be beneficial to pass on at least a portion of it to its customers to induce a higher demand level, has not yet been addressed. In an attempt to bridge this gap, the present study considers both the DPP and the DOP options for a profit maximizing retailer with a price-dependent demand. The basic model for both options is presented in the next section, together with the derivation of the optimality conditions. In accordance with the empirical evidence alluded to earlier, the model considers the optimal determination of the amount of discount to be passed on to the customers and the quantity eligible for such a discount. This is followed in Section 3 by an analytical and numerical comparison of the resulting policies. Conclusions given in Section 5 completes the paper.

2. Components of the buyer's decision models for the two options

The first step in the modelling process is to determine the length of the planning horizon to be used for comparability between the two options. Even if the inventory problem under consideration is an infinite horizon problem, all that is required for the evaluation of DOP and DPP is a period long enough to cover the depletion periods of the special orders placed by the retailer in response to the two options. Since it is not clear a priori which depletion period is larger, a one-year planning horizon is selected and the time-dependent parameters and variables are defined accordingly. However, should at least one of the depletion periods exceed one year in length, as it will be for some portions of the analysis in Section 4, a longer one may be selected without adding complexity to the model. The potential time difference between the end of the depletion period and that of the planning horizon indicates the need for the calculation of the buyer's profit for the no-incentive in-between period. Following the standard assumption of Naddor [30], its value corresponds to the fraction of the yearly no-incentive profit represented by the length of the in-between period. This necessitates the derivation of a profit function for the no-incentive situation to go along with the those corresponding to the DPP and the DOP options. An important ingredient of this derivation is the modelling of the price-dependent demand, denoted by R_j, $j = 0, 1, 2$ ($j = 0$ represents the no-incentive case) and defined by the standard downward-sloping price-dependent demand, as follows:

$$R_j = R(P_j) \quad \text{with } \partial R_j/\partial P_j = R_j' < 0,$$

$$\partial^2 R_j/\partial^2 P_j = R_j'' \text{ unrestricted in sign} \quad \text{for } j = 0, 1, 2. \qquad (1)$$

The economics and operations management literature adds another restriction to R_j, namely that of concavity, which requires $R_j'' > 0$. With this condition added to (1), demand is assumed to decrease at an increasing rate as price rises. Tyagi [23] considers also convex demand functions, which under certain conditions, may yield greater than 100% retail pass-through behaviour. That R_j'' in (1) is unrestricted in sign indicates that the models of this paper can accommodate both, convex and concave demand functions.

Table 1 lists the various elements of the profit functions. Profits may be decomposed into two components. One, associated with the first cycle, covers the special-order period of length as listed in Table 1. The other covers the rest of the planning horizon. It should be emphasized once again that the no-incentive policy is not an option per se, but, as shown below, it forms part of the other two and has a similar cost/revenue structure. However, for comparability purposes to the DPP and DOP options, its first cycle, of equal length, Q_0/R_0, to all other cycles, is also described in detail. Hence, for the no-incentive policy, $j = 0$, the revenue for the special cycle is generated by the sale of the first Q_0 units at the regular price, P_0. The functional form of the