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A comprehensive extension of an integrated inventory model with ordering cost reduction and permissible delay in payments

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ABSTRACT

Huang (2010) [1] proposed an integrated inventory model with trade credit financing in which the vendor decides its production lot size while the buyer determines its expenditure to minimize the annual integrated total cost for both the vendor and the buyer. In this paper, we extend his integrated supply chain model to reflect the following four facts: (1) generated sales revenue is deposited in an interest-bearing account for the buyer, (2) the buyer's interest earned is not always less than or equal to its interest charged, (3) the total number of shipments in one lot size is the vendor's decision variable to minimize the cost, and (4) it is vital to have a discrimination term which can determine whether the buyer's replenishment cycle time is less than the permissible delay period or not. We then derive the necessary and sufficient conditions to obtain the optimal solution, and establish some theoretical results to characterize the optimal solution. Finally, numerical examples are presented to illustrate the proposed model and its optimal solution.

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1. Introduction

In practice, vendors usually offer their buyers a permissible delay in payments. During the permissible delay period, there is no interest charge. Hence, buyers can earn the interest from sales revenue meanwhile vendors lose the interest earned during the same period. However, if the payment is not paid in full by the end of the permissible delay period, then vendors charge buyers an interest on the unpaid amount of the purchasing cost. The permissible delay in payments produces two benefits to the vendor: (1) it attracts new buyers who consider it to be a type of inventory cost reduction, and (2) it is an alternative to price competition because it does not provoke competitors to reduce their prices and thus introduce lasting price reductions. On the other hand, the policy of granting trade credit financing adds not only an additional opportunity cost but also an additional dimension of default risk to the vendor.

Goyal [2] developed an economic order quantity (EOQ) model for the buyer when the seller offers a permissible delay in payments. Shah [3] considered a stochastic inventory model when delays in payments are permissible. Jamal et al. [4] extended Goyal's model to allow for shortages. Hwang and Shinn [5] added the pricing strategy to the model, and derived the optimal price and lot sizing for a retailer under the condition of permissible delay in payments. Teng [6] provided an alternative conclusion from Goyal [2], and proved that it makes economic sense for a well-established buyer to order less quantity and take the benefits of the permissible delay more frequently. Chang et al. [7] developed an EOQ model for deteriorating items under supplier credits linked to ordering quantity. Huang [8] extended Goyal's model to develop an EOQ model in which the supplier offers the retailer the up-stream trade credit period M , and the retailer in turn provides the down-stream trade credit period N (with $N \leq M$) to his/her customers. Teng and Goyal [9] complemented the shortcoming

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