Int. J. Production Economics 114 (2008) 308–312

Contents lists available at ScienceDirect

Int. J. Production Economics

journal homepage: www.elsevier.com/locate/ijpe

Comments on the EOQ model under retailer partial trade credit policy in the supply chain

Kun-Jen Chung *

College of Business, Chung Yuan Christian University, Chung Li, Taiwan, ROC

ARTICLE INFO

Article history:
Received 13 September 2007
Accepted 26 February 2008
Available online 3 March 2008

Keywords:
EOQ
Inventory
Partial trade credit
Supply chain

ABSTRACT

Huang and Hsu [2007. An EOQ model under retailer partial trade credit policy in supply chain. International Journal of Production Economics, doi:10.1016/j.ijpe.2007.05.014] investigate the inventory system as a cost minimization problem to determine the retailer's optimal inventory policy under the supply chain. They develop two easy-to-use theorems to locate the optimal inventory policy for the retailer. Although their inventory models are correct and interesting, processes of arguments to derive those theorems to find the optimal inventory policy are not complete. So the main purpose of this paper is to overcome these shortcomings and present complete proofs for Huang and Hsu (2007).
© 2008 Published by Elsevier B.V.

1. Introduction

Goyal (1985) is the first person to develop a single-item inventory model under permissible delay in payments. He assumes that the supplier would offer the retailer trade credit but the retailer would not offer the trade credit to the customer. Huang (2003) modifies Goyal (1985) to assume that the retailer will also adopt the trade credit policy to stimulate customer's demands. The viewpoint of Huang (2003) is called two levels of trade credit. Huang (2006) incorporates Huang (2003) and Teng (2002) to investigate two levels of trade credit and limited storage space. Recently, Liao (2007) considers an EOQ model with non-instantaneous receipt and exponentially deteriorating items under two-level trade credit. Chung and Huang (2007) explore the optimal retailer's ordering policies for deteriorating items with limited storage capacity under trade credit financing. Subsequently, Huang (2007) combines both Huang (2003) and Chung and Huang (2003) to develop an optimal retailer's replenishment decision in the EPQ model under two levels of trade credit policy. Furthermore, Huang and Hsu (2007) consider another kind of two levels of trade credit and present an EOQ model under the retailer partial trade credit policy in supply chain. Basically, their inventory model is correct and interesting. They establish two easy-to-use theorems to characterize the optimal policy; however, processes of arguments to derive those theorems are not complete. So, the main purpose of this paper is to overcome those shortcomings and present complete proofs for Huang and Hsu (2007).

2. Model formulation

The following notation and assumptions will be used throughout the paper.

Notation:

D = demand rate per year
A = ordering cost per order
c = unit purchasing price
s = unit selling price, $s \geqslant c$
h = unit stock holding cost per year excluding interest charges
α = the customer's fraction of the total amount owed payable at the time of placing an order offered by retailer, $0 \leqslant \alpha \leqslant 1$

* Fax: +886 3 2655099.
E-mail address: kjchung@cycu.edu.tw

0925-5273/$ - see front matter © 2008 Published by Elsevier B.V.
doi:10.1016/j.ijpe.2008.02.010

I_e = interest earned per \$ per year
I_k = interest charged per \$ in stocks per year by the supplier
M = the retailer's trade credit period offered by the supplier in years
N = the customer's trade credit period offered by the retailer in years
T = the cycle time in years
TRC(T) = the annual total relevant cost, which is a function of T
T^* = the optimal cycle time of TRC(T)
Q^* = the optimal order quantity = DT*

Assumptions:

(1) Demand rate, D, is known and constant.
(2) Shortages are not allowed.
(3) Time horizon is infinite.
(4) Replenishments are instantaneous.
(5) The supplier offers the full trade credit to the retailer. When $T \geqslant M$, the account is settled at $T=M$; the retailer pays off all units sold and keeps his/her profits, and starts paying for the interest charges on the items in stock with rate I_k. When $T \leqslant M$, the account is settled at $T=M$ and the retailer does not need to pay any interest charge.
(6) The retailer just offers the partial trade credit to his/her customer. Hence, his/her customer must make a partial payment to the retailer when the item is sold. Then his/her customer must pay off the remaining balance at the end of the trade credit period offered by the retailer. That is, the retailer can accumulate interest from his/her customer payment with rate I_e.

The annual total relevant cost consists of the following elements. Two situations may arise. (I) $M \geqslant N$ and (II) $M<N$.

Case I: Suppose that $M \geqslant N$. In this case, Huang and Hsu (2007) show that the annual total relevant cost TRC(T) can be expressed as follows:

$$\mathrm{TRC}(T)=\begin{cases}\mathrm{TRC}_1(T) & \text{if } T \geqslant M\\ \mathrm{TRC}_2(T) & \text{if } N \leqslant T \leqslant M\\ \mathrm{TRC}_3(T) & \text{if } 0<T \leqslant N\end{cases} \tag{1a–c}$$

where

$$\mathrm{TRC}_1(T)=\frac{A}{T}+\frac{DTh}{2}+cI_kD(T-M)^2/2T - sI_eD[M^2-(1-\alpha)N^2]/2T \tag{2}$$

$$\mathrm{TRC}_2(T)=\frac{A}{T}+\frac{DTh}{2} - sI_eD[2MT-(1-\alpha)N^2-T^2]/2T \tag{3}$$

and

$$\mathrm{TRC}_3(T)=\frac{A}{T}+\frac{DTh}{2}-sI_eD\left[M-(1-\alpha)N-\frac{\alpha T}{2}\right] \tag{4}$$

Since $\mathrm{TRC}_1(M)=\mathrm{TRC}_2(M)$ and $\mathrm{TRC}_2(N)=\mathrm{TRC}_3(N)$, TRC($T$) is continuous and well-defined. All $\mathrm{TRC}_1(T)$, $\mathrm{TRC}_2(T)$, $\mathrm{TRC}_3(T)$ and TRC(T) are defined on $T>0$.

Case II: Suppose that $M<N$. In this case, Huang and Hsu (2007) show that the annual total relevant cost TRC(T) can be expressed as follows:

$$\mathrm{TRC}(T)=\begin{cases}\mathrm{TRC}_4(T) & \text{if } T \geqslant M\\ \mathrm{TRC}_5(T) & \text{if } 0<T \leqslant M\end{cases} \tag{5a,b}$$

where

$$\mathrm{TRC}_4(T)=\frac{A}{T}+\frac{DTh}{2}+cI_kD(T-M)^2/2T - sI_eD\alpha M^2/2T \tag{6}$$

and

$$\mathrm{TRC}_5(T)=\frac{A}{T}+\frac{DTh}{2}-sI_eD\left[\alpha M-\frac{\alpha T}{2}\right] \tag{7}$$

Since $\mathrm{TRC}_4(M)=\mathrm{TRC}_5(M)$, TRC($T$) is continuous and well defined. All TRC_4, $\mathrm{TRC}_5(T)$ and TRC(T) are defined on $T>0$.

3. The convexity of TRC(T)

Case I: $M \geqslant N$. Eqs. (2)–(4) yield

$$\mathrm{TRC}_1'(T)=-\left[\frac{2A+cDM^2I_k-sDI_e(M^2-(1-\alpha)N^2)}{2T^2}\right] + D\left(\frac{h+cI_k}{2}\right) \tag{8}$$

$$\mathrm{TRC}_1''(T)=\frac{2A+cDM^2I_k-sDI_e(M^2-(1-\alpha)N^2)}{T^3} \tag{9}$$

$$\mathrm{TRC}_2'(T)=-\left[\frac{2A+sD(1-\alpha)N^2I_e}{2T^2}\right]+D\left(\frac{h+sI_e}{2}\right) \tag{10}$$

$$\mathrm{TRC}_2''(T)=\frac{2A+sD(1-\alpha)N^2I_e}{T^3}>0 \tag{11}$$

$$\mathrm{TRC}_3'(T)=\frac{-A}{T^2}+D\left(\frac{h+s\alpha I_e}{2}\right) \tag{12}$$

and

$$\mathrm{TRC}_3''(T)=\frac{2A}{T^3}>0 \tag{13}$$

Eqs. (11) and (13) imply that $\mathrm{TRC}_2(T)$ and $\mathrm{TRC}_3(T)$ are convex on $T>0$ and Eq. (6) implies that $\mathrm{TRC}_1(T)$ is convex on $T>0$ when $2A+cDM^2I_k-sDI_e(M^2-(1-\alpha)N^2)>0$. Furthermore, we have $\mathrm{TRC}_1'(M)=\mathrm{TRC}_2'(M)$ and $\mathrm{TRC}_2'(N)=\mathrm{TRC}_3'(N)$. Therefore, Eqs. (1a–c) imply that TRC(T) is convex on $T>0$ when $2A+cDM^2I_k-sDI_e(M^2-(1-\alpha)N^2)>0$.

Let

$$G=2A+cDM^2I_k-sDI_e(M^2-(1-\alpha)N^2) \tag{14}$$

Then, we have the following results.

Lemma 1. *Suppose that $M \geqslant N$. Hence,*

(A) If $G \leqslant 0$, then TRC(T) is convex on $(0, M]$ and concave on $[M, \infty)$. Furthermore, if $G \leqslant 0$, then $\mathrm{TRC}_1'(T)>0$ and $\mathrm{TRC}_1(T)$ is increasing on $T>0$.
(B) If $G>0$, then TRC(T) is convex on $(0, \infty)$.

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات