60 days, then 8% interest (ie, $I_c = 0.08$) is charged on the outstanding amount. We assume that the customer purchases by a credit card (ie $N = 1/12$), $D = 3600$ units, $h = \$0.5/\text{unit}/\text{year}$, $A = \$10$ per order and $I_e = 5\%$ if the store deposits its revenue into a money-market account; or $I_e = 10\%$ if it invests its revenue into a mutual fund account.

Since $\Delta_1 \equiv 2A - (h + pI_e)D(M - N)^2 = 20 - (0.5 + I_e)(3600)(1/12)^2 > 0$ for $I_e = 5\%$ or 10% , we know from Theorem 1 that the optimal replenishment interval is $T^* = T_1^*$. Substituting the numerical values into (22), we obtain the optimal EOQ Q_1^* as follows.

$$Q_1^* = \begin{cases} 362.86 & \text{if } I_e = 5\% \\ 351.19 & \text{if } I_e = 10\% \end{cases} \quad (26)$$

From (23), we have the classical optimal EOQ (ie $M = N = 0$)

$$Q_4^* = \sqrt{2AD/(h + cI_c)} = 365.15 \quad (27)$$

The results in (26) and (27) reveal that if $pI_e > cI_c$, then the store should order less quantity than the classical EOQ, and take the benefits of the permissible delay more frequently, and vice versa.

Conclusions

In this paper, we extend the model given in Huang (2003) to allow for the following two important facts: (1) since the retailer offers its customers a permissible delay period N , the retailer receives its revenue from N to $T + N$; and (2) in reality, the unit selling price p is significantly higher than the unit cost c . In addition, we also relax the dispensable assumptions of $I_c > I_e$ and $N \leq M$. We then propose the generalized formulation to the problem, and establish the theoretical results to obtain the optimal solution. Finally, we provide a real-world inventory problem to illustrate the proposed model and its optimal solution. We believe that this paper will work as a solid foundation for the future study in this research area for years to come.

For further research, this paper can be extended in several ways. For instance, we may add the constant deterioration rate for the items. Also, we could consider the imperfect quality in the production process. Finally, we could generalize the model to allow for shortages, quantity discounts, inflation rates and others.

Acknowledgements—The authors would like to thank the editors for their constructive suggestions. We also deeply appreciate Professor Liang-Ho Chen for his three excellent graphical figures. This research was supported by a summer research grant from the William Paterson University of New Jersey, USA.

References

Aggarwal SP and Jaggi CK (1995). Ordering policies of deteriorating items under permissible delay in payments. *J Opl Res Soc* **46**: 658–662.

- Arcelus FJ and Srinivasan G (1993). Delay of payments for extraordinary purchases. *J Opl Res Soc* **44**: 785–795.
- Brigham EF (1995). *Fundamentals of Financial Management*. The Dryden Press: Florida.
- Chang CT, Ouyang LY and Teng JT (2003). An EOQ model for deteriorating items under supplier credits linked to ordering quantity. *Appl Math Model* **27**: 983–996.
- Chung KJ (1998). A theorem on the determination of economic order quantity under conditions of permissible delay in payments. *Comput Opns Res* **25**: 49–52.
- Davis RA and Gaither N (1985). Optimal ordering policies under conditions of extended payment privileges. *Mngt Sci* **31**: 499–509.
- Goyal SK (1985). Economic order quantity under conditions of permissible delay in payments. *J Opl Res Soc* **36**: 335–338.
- Huang YF (2003). Optimal retailer's ordering policies in the EOQ model under trade credit financing. *J Opl Res Soc* **54**: 1011–1015.
- Jamal AMM, Sarker BR and Wang S (1997). An ordering policy for deteriorating items with allowable shortage and permissible delay in payment. *J Opl Res Soc* **48**: 826–833.
- Ouyang LY, Chang CT and Teng JT (2005). An EOQ model for deteriorating items under trade credits. *J Opl Res Soc* **56**: 719–726.
- Teng JT (2002). On the economic order quantity under conditions of permissible delay in payments. *J Opl Res Soc* **53**: 915–918.
- Teng JT, Ouyang LY and Chen LH (2006). Optimal manufacturer's pricing and lot-sizing policies under trade credit financing. *Int Trans Opl Res* **13**: 515–528.

The William Paterson University of
New Jersey
Concordia University

J-T Teng
SK Goyal

Reply to 'Optimal ordering policies for a retailer in a supply chain with up-stream and down-stream trade credits' by Teng and Goyal

Journal of the Operational Research Society (2007) **58**, 1255.
doi:10.1057/palgrave.jors.2602440

Recently, Huang (2003) established an economic order quantity model under two-level trade credit policy in which the supplier offers the retailer a permissible delay period M , and the retailer in turn provides its customer a permissible delay period N (with $N < M$). Huang's model followed Goyal's model (1985) assumption that unit selling price s is equal to the unit cost c to develop his model. Under this situation, the assumptions of $N < M$ is reasonable. This viewpoint relaxes the assumption of $s = c$ to $s \geq c$ to remodel his inventory model and establish the theoretical results to obtain optimal solution. That is, this viewpoint generalizes Huang's model to fit the real-life situation to increase the practical contribution.

References

- Goyal SK (1985). Economic order quantity under conditions of permissible delay in payments. *J Opl Res Soc* **36**: 335–338.
- Huang YF (2003). Optimal retailer's ordering policies in the EOQ model under trade credit financing. *J Opl Res Soc* **54**: 1011–1015.

Chaoyang University of Technology,
Taichung, Taiwan

YF Huang