Chapter 12

Stackelberg Game Inventory Model With Progressive Permissible Delay of Payment Scheme

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ABSTRACT

Supplier has many schemes to motivate retailer to buy more and of them one is a progressive permissible delay of payment. Instead of analyst from the retailer side alone, in this chapter, we develop the inventory model of supplier and retailer. In reality, some suppliers and retailers cannot have collaboration and they try to optimize their own decision so we develop a Stackelberg Game model. Two models are developed wherein the first model supplier acts as the leader and in the second model, the retailer acts a leader. Since the models are complex, a hybrid Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) is developed to solve the model. A numerical analysis and sensitivity analysis are conducted to get management insights of the model. The results show that a Stackelberg Game model for progressive permissible delay of payment is sensitive in varies values of the first and second delay interest rate if supplier acts as a leader. The retailer gets less inventory cost when he acts as a leader compared to when vendor acts a leader at high interest rate of the first and second delay period.

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INTRODUCTION

In order to motivate customers to buy more from supplier, supplier apply some scheme such as dynamic pricing, quantity discount gift on purchase and permissible delay of payments. Trade credit in the form of permissible delay of payment affects the conduct of business significantly (Jaggi et al., 2013). In permissible delay of payment buyer does not have to pay the supplier immediately after receiving the goods but can delay the payment until the allowable time period. Buyer can get benefit from interest earn form goods that have been sold. Many research have been conducted by considering permissible delay of payment in inventory. Huang (2005) developed a buyer’s inventory model by considering delay of payment and cash discount. Inventory model with collaboration between supplier and retailer by considering permissible delay of payment was developed by Jaber and Osman (2006). They concluded that coordination with permissible delay in payment is better than no-coordination system. Similar research of inventory model with permissible delay of payment under collaboration between single-vendor and single-buyer for deteriorating items was developed by Yang and Wee (2006). They found that permissible delay of payment is a win-win strategy when implemented under collaboration system. Liao (2007) developed deteriorating economic production quantity model by considering permissible delay in payments. Tsao and Sheen (2008) did not consider permissible delay of payment for deteriorating inventory model but they also include other schemes which are dynamic pricing and promotion. Instead only collaboration between supplier and retailer, Jaggi et al. (2008) developed an inventory model with two levels of credit policy. In their model supplier gives a fixed credit period to the retailer and retailer offer credit period to customers. Inventory model with permissible delay of payment by considering allowable shortage was introduced by Chung and Huang (2009). Huang et al. (2010) developed single-vendor single buyer integrated inventory model considering permissible delay of payments and order time reduction that can be attained through procedural changes, worker training and specialized equipment acquisition. Sarkar (2012) developed an EOQ model by considering stock dependent demand, production defective items and delay of payment scheme.

Soni and Shah (2008) develop an inventory model with stock dependent demand and progressive payment scheme. Progressive scheme is a variant of permissible delay of payment. In progressive payments scheme, there is more than one payment period. The supplier does not charge any interest if the buyer pays before the first payment period but interest will be charged after the first payment period and become higher for the next payment period. Similar payment scheme model using two-levels of credit policy was developed by Jaggi et al. (2012). This chapter tries to extend the work of Soni and Shah (2008) by considering not only retailers but supplier and retailer decisions simultaneously in just in time inventory model. Since supplier and the retailer try to optimize their own decision, the model is developed as a non-cooperative model. Single vendor-single buyer non-cooperative models with permissible delay in payments are developed using Stackelberg equilibrium (Chern et al., 2013) and under Nash equilibrium (Chern et al.,2014). Teng et al. (2012) studied vendor-buyer inventory model with credit financing for both integrated and non-cooperative environment. They concluded that vendor should offer short permissible delay payment to reduce its cost. Li et al. (2014) introduced an inventory model with a transferable utility game under permissible delay of payment scheme. Supplier sells the same commodities and gives the retailers delay of payments.

Stackelberg Game can be described as follows: a leader of this game, for example a supplier, who knows the decision process of his buyers will react to maximize his own profit. The buyer, as a follower, answers the supplier’s decision by setting new decision to improve his profit. On the other side, buyer
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