Chapter 20
Joint Decision for Price Competitive Inventory Model with Time–Price and Credit Period Dependent Demand

Nita H. Shah
Gujarat University, India

ABSTRACT
The problem analyzes a supply chain comprised of two front-runner retailers and one supplier. The retailers’ offer customers delay in payments to settle the accounts against the purchases which is received by the supplier. The market demand of the retailer depends on time, retail price and a credit period offered to the customers with that of the other retailer. The supplier gives items with same wholesale price and credit period to the retailers. The joint and independent decisions are analyzed and validated numerically.

INTRODUCTION
For a firm, price of the product and change of behavior of customers with time for the product are very important issues to formulate marketing strategies. The firm uses delay in payments as a promotional tool to boost customer’s demand which depends on the retail price of the product. Choi (1991) studied channel competition with two competing manufactures and one retailer. He studied effect of cost differences on equilibrium prices and profits using Stackelberg and Nash games. Ingene and Parry (1995) worked out policy under which a manufacturer does a business with heterogeneous retailers and non-identical competing retailers. They advocated a manufacturer to offer two-part payment policies against quantity discount. Yao and Liu (2005) analyzed the pricing equilibrium between a manufacturer with an e-tail channel and a manufacturer with a retail channel for Bertrand and Stackelberg price competition models. Xie and Wei (2009) considered price dependent demand with advertisement. They concluded that the coordinated decision is beneficial. Li et al. (2010) discussed a model when supply disrupts for a single-retailer and two suppliers. Sinha and Sarmah (2010) studied the problem of price competition

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without channel coordination, and global coordination in a two-stage distribution channel where two retailers deal with two differentiated products using a common distributor. For more studies on inventory models with pricing policy models read Pal et al. (2012), Sana (2011), Sona and Choudhuri (2008), Wei and Chen (2011), Wu et al. (2012) and their cited references.

Now-a-days, trade credit is considered to be a bridge between two players where one player supplies order but receives payment after/on pre-specified date. This tool helps both the players to boost their demands. Goyal (1985) formulated economic order quantity model when a player offers delay period to settle the accounts due against the purchases. Refer to review article by Shah et al. (2011) on inventory modeling and trade credit. Huang (2003) formulated inventory policies with two-level trade credit scheme. Chung et al. (2005) discussed model when order quantity depends on the credit period. Ho (2011) studied integrated decision for supplier-retailer supply chain by assuming that the credit period offered by the supplier is longer than that of the retailer who passes it to the customer when demand is price and customer’s credit period sensitive. Zhou et al. (2012) studied decision rules for a supply chain comprising of supplier-retailer when floor space is constraint for the retailer. Shah and Shah (2012) extended above problem for constant rate of deterioration of items and fuzzy demand. Pal et al. (2014) studied two-echelon competitive integrated supply chain with price and credit period dependent demand. They assumed that the wholesale price and credit periods offered by the supplier to the two retailers are same and demand of one retailer depends on the selling price of the other retailer.

In this chapter, a competitive supply chain comprising of two antagonist retailers dealing with one common supplier is analyzed. The retailers compete with each other in terms of time, price and credit period to increase their profits. The demand decreases with time and sensitive to retail price and length of credit periods offered to the customers by both the antagonist retailers. The coordinated objective function of supply chain is maximized. The independent decision is maximized using vertical Nash equilibrium. The rest of the chapter is organized as follows. The notations and assumptions are given in section 2, the mathematical model is formulated in section 3. Section 4 validates mathematical development using numerical data and a conclusion is given in section 5.

ASSUMPTIONS AND NOTATIONS

Notations

The problem stated uses the following notations:

\[ i = 1, 2 \]

\[ C : \text{Purchase cost / item of the supplier (in$)} \]

\[ w : \text{Wholesale price / item set by the supplier (in$)} \]

\[ P_i : \text{Retail price for the } i\text{th retailer (in$)} \]

\[ R_i(t,N_i,P_i) : \text{Demand rate for the } i\text{th retailer} \]

\[ N_i : \text{Credit period offered by the } i\text{th retailer to the customer (in years)} \]

\[ M : \text{Credit period offered by the supplier to the retailer (in years)} \]

\[ I_c : \text{Interest payable per$ / unit time} \]

\[ I_e : \text{Interest earned per$ per unit time; } (I_e < I_c) \]

\[ T_i : \text{Replenishment time for the } i\text{th retailer (in years)} \]