Abstract

Profits of a firm are mainly driven by two factors – (1) the quantity the firm stocks, and (2) the unit selling price the firm sets. The quantity a firm stocks plays a vital role in determining the revenues it earns by limiting the quantum of sales it can make, and in determining the holding and shortage costs it incurs. It has been well proven and understood from the extant literature on Inventory Theory that inefficient inventory management leads to high costs that erode a firm's profits. The second factor, namely the price at which a firm lists its product, determines the contribution that the firm earns on every unit it sells. The literature on Pricing Theory explores various schemes that firms can adopt to efficiently manage prices to maximize profits.

In practice, demand is price-sensitive and a firm can influence the demand it faces through the price it sets. A firm's production and inventory decisions are made based on the demand that it faces. Hence, the price a firm sets indirectly affects its inventory policies, through the demand it faces. Moreover, the price a firm sets may also be influenced by the magnitude of inventory it holds. For large inventories, the price set tends to be low while for low inventories, it tends to be high. Due to this mutual interaction between the pricing and the inventory policies followed by a firm, it is essential that firms simultaneously decide their selling prices and inventory policies, in order to maximize their profits. That is, firms have to coordinate their pricing and inventory management to maximize their profits. The research question we try to answer in this thesis is: How should firms coordinate their pricing and inventory decisions to arrive at efficient policies that maximize their profits? We answer this question in different business contexts (or supply chains).

The current thesis aims at exploring the joint sourcing and pricing issues in the following three different business contexts.

1. New product introduction when product shortage creates hype that results in additional demand,

2. Deteriorating products under Cournot duopoly when selling price is dependent on the product's availability and quality, and

3. Perishable products when consumers are free to choose among units of different ages.

In the first problem, we analyse the optimal joint inventory/production and pricing

policies of a monopolist when introducing a new product whose shortage may create additional demand due to hype. Hype is observed if the product is a major success and we term this condition as high demand for the product. A product that experiences low demand can be thought of as an unsuccessful product, and such a product does not exhibit hype. The product is successful, that is, experiences a high demand, with an exogenous probability that is known to the firm. The firm launches the product at the beginning of a two-period horizon during which the sales occur and the product's shortage in the initial period enhances (due to hype) the demand in the subsequent period, when the product is successful. Though the firm knows the probability of success of its product, the actual state, success or failure, of the product is learnt after observing the demand during the first period. The firm has to simultaneously decide the production quantities and the selling prices in the two periods with an objective of maximizing its expected profit.

In addition to deriving some structural properties of the optimal prices and inventory levels, we show that (i) firms do not always exploit hype, (ii) firms do not always increase the price of a successful product in the second period, (iii) firms may price out an unsuccessful product in the first period when the success probability is above a threshold, and (iv) such a threshold probability is decreasing in the first period market potential of the successful product.

In the second context, we address the problem of joint inventory and quality management of a seasonally produced perishable commodity under Cournot duopoly, when sales occur over a multi-period horizon. The good that is produced during a season has to be preserved in order to be sold during the future non-production periods of a year. The price that a firm can set depends on the extent of the product's availability in the market, and on the product quality that the firm offers. Though the quality of the product is the highest when produced, the firms have to invest in retaining the quality of the product when storing it for future periods. Using deterministic inverse demand functions, we model the problem as a complete information two-period, two-player non-cooperative game where the objective function of each player is a two stage dynamic program. The inventory replenishment occurs at the beginning of the two-period horizon.

We discuss the joint stocking and quality management for two kinds of perishable products, namely slow-deteriorating products, and fast-deteriorating products. In the case of a slow-deteriorating product, the firms' decisions comprise of only stocking levels of the two periods. We solve this problem when the production yield of a firm is its private information. In the case of a fast-deteriorating product, the firms have to also decide the iii

quality level of the second period inventory, apart from deciding the stocking levels of both the periods. We develop models to explore the impact of quality costs on the firms' choices and identify the trade-offs that the firms perform among their production costs, quality costs and the quality levels.

In the third context, we address the problem of joint inventory and pricing management for perishable goods when a retailer offers both new and old units simultaneously for sale, and the consumers are free to choose between them based on their affordability. We model the problem as an infinite-horizon Markov decision process (MDP) and prove that when market prices are sticky, the optimal steady state policy is myopic when the product's life is two periods. For all other lifetimes of the product, we show that the policy cannot have a myopic structure.

For each of the above contexts, we discuss numerical examples to draw insights and to provide counter examples as proofs, wherever applicable.