Asia Pacific Management Review xxx (2016) 1–7

HOSTED BY

ELSEVIER

Contents lists available at ScienceDirect

Asia Pacific Management Review

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

A return-policy contract with a stock-dependent demand and inventory shrinkages

Kuo-Hsien Wang [a,*], Yuan-Chih Huang [b], Che-Tsung Tung [c]

[a] Department of Business Administration, Takming University of Science and Technology, Taipei, Taiwan
[b] Department of Business Administration, Takming University of Science and Technology, Taipei, Taiwan
[c] Department of International Trade, Takming University of Science and Technology, Taipei, Taiwan

ARTICLE INFO

Article history:
Received 3 March 2015
Accepted 15 February 2016
Available online xxx

Keywords:
Newsvendor
Supply chain
Stock-dependent demand
Inventory

ABSTRACT

We study a decentralized supply chain in which a manufacturer supplies a newsvendor-type item to a retailer in a stock-dependent demand market, considering temporary and permanent inventory shrinkages. The manufacturer offers a cheaper-wholesale-price, buy-all-back contract to operate the chain as a centralized supply chain. The purpose is to coordinate the chain and create a win–win situation by jointly determining the order quantity and negotiating the wholesale price. We consider the retailer's ignorance of inventory errors and unwillingness to share information, and we construct a range for the negotiated wholesale price in which it not only achieves Pareto efficiency but also encourages the retailer's cooperation with the inventory information. We find that the retailer bears more risk for inventory errors even when our contract is in place. We also learn that the impact of the stock-level demand stimulation effect on chain profit outweighs the impact of the inventory errors if the levels of inventory shrinkage are below our obtained upper bounds.

© 2016 College of Management, National Cheng Kung University. Production and hosting by Elsevier Taiwan LLC. All rights reserved.

1. Introduction

Within a decentralized supply chain, if a manufacturer and a retailer are each seeking to optimize their own profits, then it will generate a so-called “double-marginalization” phenomenon (Spengler, 1950). This phenomenon will lead the chain to poor channel profit performances as a result of a less optimal order quantity in comparison to a coordinated supply chain. Thus, contractual terms enhancing a chain's profit efficiency in a decentralized supply chain setting have become imperative to achieve two purposes, supply chain coordination and Pareto efficiency. A contract is said to coordinate a chain if it maximizes the chain's profit as a whole; a contract is said to be Pareto-efficient if each member's profit is no worse off when the contract is in place than it would be in the event of other default contracts (Bose & Anand, 2007).

A price-only contract is widely considered as a basic, simple trade-off in the existing literature. In such an agreement, a manufacturer offers no incentive to retailer(s), and the retailer(s) then takes all responsibilities for excess inventory at the end of the selling period. However, researchers, including Lariviere and Porteus (2001), Cachon (2003) and Bernstein and Federgruen (2005), proved that the price-only contract fails to coordinate a supply chain. Conversely, a return-policy contract mitigating the risk of over-stocking due to market demand uncertainty is a commitment made by a manufacturer to accept his partner's unsold products (Padmanabhan & Png, 1995). Pasternack (1985), who was the first to analyze manufacturer-retailer channel coordination via return policies for seasonal items, contended that return policies could be used as an instrument for supply chain coordination. Since then, a number of related articles have been published. Emmons and Gilbert (1998) investigated the role of return policies in pricing and inventory decisions for catalogue goods. Meanwhile, Lau, Lau, and Willett (2000) studied the problem of demand uncertainty and return policy for a seasonal product. Tsay (1999) researched a quantity flexibility contract in a newsvendor supply chain, whereas Yao, Wu, and Lai (2005) addressed demand uncertainty and manufacturer return policies for style-good retailing

* Corresponding author. Tel.: +886 2 26585801x2733.
E-mail address: wanko@takming.edu.tw (K.-H. Wang).

Peer review under responsibility of College of Management, National Cheng Kung University.

http://dx.doi.org/10.1016/j.apmrv.2016.02.001

1029-3132/© 2016 College of Management, National Cheng Kung University. Production and hosting by Elsevier Taiwan LLC. All rights reserved.

Please cite this article in press as: Wang, K.-H., et al., A return-policy contract with a stock-dependent demand and inventory shrinkages, Asia Pacific Management Review (2016), http://dx.doi.org/10.1016/j.apmrv.2016.02.001

competition. Bose and Anand (2007) contributed to a practical finding on return policies with exogenous pricing. Yao, Leung, and Lai (2008) analyzed the impact of price-sensitivity factors on a return policy coordinating a supply chain, and Chen (2011) discussed return policies with a wholesale-price-discount contract in the context of a newsvendor setting.

Empirically, stock-level demand stimulation effect has been recognized in both marketing and operations research on inventory management. For some items, such as books, magazines, fashion apparel or 3c products, displaying a large stockpile of inventory on shelf space can actually increase sales. This phenomenon is called the customers' impulse-purchase and is first introduced by Balakrishnan, Pangburn, and Stavrulaki (2008) in terms of the effects of increasing product visibility, kindling latent demand, signaling a popular product and providing an assurance of future availability. Prior to this discovery, Dana and Petruzzi (2001) also claimed that higher stock levels can increase sales because the consumer utility increases as the item's fill rate increases. A number of articles, such as Corstjens and Doyle (1981), Bultez and Naert (1988) and Eliashberg and Steinberg (1993), studied inventory demand stimulation and developed mathematical models for shelf space allocation. Gupta and Vrat (1986), Baker and Urban (1988), Goh (1992), Urban (1995) and Balakrishnan, Pangburn, and Stavrulaki (2004) all stressed the use of an optimal inventory policy with stock-level-dependent demand functions. From a retailer's perspective, Stavrulaki (2011) recently managed inventory decisions in the framework of a single-period, stock-level-dependent demand setting that is solved using the heuristic solution approach.

In addition, supply chain profit efficiency is profoundly related to the accuracy of inventory information. According to Hollinger and Adams (2010), inventory shrinkages accounted for 1.44% of total annual sales in the USA, and retailers lost more than $33 billion in 2009 as a result of inventory shrinkages. Previously, Atali, Lee, and Ozer (2006) categorized inventory errors as temporary shrinkage, permanent shrinkage and transaction error. Temporary shrinkage refers to misplacement that affects available inventory, but the misplaced inventory will be returned to the shelf at the end of the selling period. Permanent shrinkage refers to theft that affects available inventory and would not be returned. Transaction errors are scanning issues that only affect inventory records but do not impact the physical inventory. More recently, Xu, Jiang, Feng, and Tian (2012) stated that inventory records are inaccurate for 65% of the nearly 370,000 inventory records observed across 37 retail stores; 20% of the inventory records differ from their physical stock by six or more items, and approximately 12% of the records show positive inventory in stock but are actually out of stock. Thus, they explored the impact of different inventory shrinkages in a supply chain network and investigated the economic benefits of RFID technology in reducing inventory shrinkage errors.

However, none of the aforementioned articles studied a decentralized supply chain setting that simultaneously accounts for the return-policy, stock-dependent demand and inventory shrinkages. Therefore, this study contributes to existing research by bridging the gap as follows. First, an information-sharing and price-only contract in a decentralized supply chain setting is proposed as our benchmark, followed by a centralized supply chain with an optimal order quantity equal to the quantity in our return-policy contract. Next, we consider the retailer's ignorance of inventory errors and unwillingness to share information to modify the range of negotiated wholesale price. The objective of our contract is to coordinate the supply chain and enhance both parties' profits by comparison with those in price-only contracts. Meanwhile, the impact caused by inventory shrinkages, the effect of inventory demand stimulation and the neglect of inaccurate inventory records will be examined.

The remainder of this study is organized as follows. Assumptions and notations are given in Section 2 in which related models will be proposed. Numerical examples are conducted in Section 3, along with managerial insights analysis. A summary and potential research directions for future study are presented in Section 4. All proofs are presented in the Appendix.

2. The models

The problem investigated in the study is as follow: A manufacturer supplies a newsvendor-type item to a retailer in a market with stock-dependent demand variable x. To capture the stock-dependent demand effect, the cumulative distribution function and/or the probability density function of x should vary with the stocking quantity. Thus, referring to the assumption in Stavrulaki (2011), we assume the stock-dependent demand variable x follows an uniform distribution $X \sim U[a(Q),b(Q)]$, with $a(Q)=d\sqrt{Q}$ and $b(Q)=l+d\sqrt{Q}$, where Q is the order quantity, d and l are positive constants, and define $F(Q,\bullet)$ and $f(Q,\bullet)$ as cdf and pdf, respectively. The reasons to assume the uniformly distributed demand are, according to Stavrulaki (2011), both its popular adoption when enough historical data are not available to estimate the exact demand and its provision of closed-form expressions for optimal values and managerial insights. Moreover, based on Stavrulaki (2011), an increasing demand condition and a saturation condition are two intuitive conditions for an item's demand cdf to capture the demand stimulation effect. The increasing demand condition specifies that because stocking quantity increases its demand, the cdf thus decreases in the stocking quantity, that is, $\partial F(Q,x)/\partial Q<0$. The saturation condition specifies the diminishing returns due to inventory promotion effect, that is, $\partial^2 F(Q,x)/\partial Q^2 \geq 0$. For further details, please refer to Stavrulaki (2011). Obviously, our assumed $F(Q,x)$ fits the two conditions. Additionally, r is the unit retail price; w is the unit wholesale price; c is the unit production cost; and s is the unit salvage value for unsold products with $s<r$. Let $\alpha \in [0,1)$ be a ratio representing the temporary inventory shrinkage that would be returned for salvage and $\beta \in [0,1)$ be a ratio representing permanent inventory shrinkage that would not be returned; $\alpha+\beta \in [0,1)$ is also assumed. Define $\delta = 1-\alpha-\beta$; thus, $(1-\beta)Q$ is the total number of products in the store, including the misplaced inventory αQ and the available inventory δQ on the shelves for sale.

2.1. The information-sharing, price-only contact

In this scenario, the retailer shares his inventory error information α and β with the manufacturer in order to determine the order quantity Q that will maximize his expected profit after the manufacturer's announcement of the wholesale price w before the selling period. The excess inventory will be salvaged at the end of the selling period.

Accordingly, the retailer's and manufacturer's expected profits, denoted by $\pi_r(Q)$ and $\pi_m(w)$, respectively, are given by

$$\pi_r(Q) = -wQ + \int_{a(Q)}^{\delta Q} (rx + s((1-\beta)Q - x)) f(Q,x)dx + \int_{\delta Q}^{b(Q)} (r\delta Q + s\alpha Q) f(Q,x)dx \tag{1}$$

$$\pi_m(w) = (w-c)Q \tag{2}$$

The first term in Eq. (1) is the retailer's purchasing cost, and the next two terms are revenues, including sales and salvages, respectively. Hence, according to Eq. (1), the following result is obtained.

Download English Version:

https://daneshyari.com/en/article/5110599

Download Persian Version:

https://daneshyari.com/article/5110599

Daneshyari.com