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Supply chain coordination through rebate induced contracts

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ARTICLE INFO	ABSTRACT
	In this paper three different types of rebate induced contract namely direct-rebate and revenue sharing contract; downward direct rebate contract; direct-rebate and effort sharing contract are proposed for supply chain coordination perspective. Effectiveness and flexibility of proposed contracts under linear and iso-elastic demand are discussed analytically. It is shown that under certain conditions both manufacturer and retailer can gain more profit by means of appropriate coordination contracts. Several important implications are derived analytically to point out relationship among characteristically different contracts. Results are illustrated with numerical examples.

1. Introduction

A growing body of literature on operations management has suggested that a high degree of supply chain integration is needed in order to optimize the performance of chain. In this paper, three different rebate and effort induced contracts, like mixing of push–pull strategies are proposed to coordinate the supply chain where the manufacturer is the Stackelberg leader. The proposed coordination policies are based on the combination of "retailer rebate" and "customer rebate". These two forms of rebate are characteristically different as retailer rebate enlarges the retailer's margin on every unit sold, whereas consumer rebate enhances the demand for the product. The marketing and economics literature have investigated the use of customer rebates as well as retailer rebate. Gerstner and Hess (1995) have examined how retailer and consumer rebate induce the retailer and how such promotions influence manufacturer and channel profits. Taylor (2002) has considered retailer rebates in a model where demand is stochastic, but the retail price is exogenously given. The author has demonstrated that the sales rebate contract that does not coordinate on its own, can coordinate the channel if it is combined with buy back contract. Krishnan et al. (2004) have focused on the use of retailer rebates in the presence of retailer efforts. Bruce et al. (2006) have analyzed trade promotions and cash rebates by explicitly incorporating a durability measure for the manufacturer's products. Chen et al. (2007) have claimed that rebates always benefit the manufacturer unless all of the buyers redeem their rebates. Aydin and Porteus (2009) have compared a per-unit retailer rebate and a per-unit customer rebate. The authors have concluded that neither the manufacturer nor the retailer always prefers one particular rebate to the other. Demirag et al. (2010) have analyzed customer rebate and retailer incentive promotions in the auto industry. (Yang et al., 2010) have shown that rebate promotions, combined with manufacturer's suggested retail pricing, can dampen price-setting retailers' possible adverse response to the promotion. Although rebate increases sales, revenues and market share; operation managers suggest that a high degree of coordination is essential for the improvement of overall supply chain performance.

Coordination of supply chain is imperative for improving its performance. By applying contractual relationships among members of a supply chain double marginalization can be eliminated. As a result optimal output of a supply chain can be obtained. Mainly, buybacks (Lee and Rhee, 2007; Xiao et al., 2010); mail-in-rebate (Chen et al., 2007) quantity discount

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(Weng, 1995; Cachon, 2003; Hsieh et al., 2010); Revenue sharing (Cachon and Lariviere, 2005; Gerchak et al., 2006); two part tariffs (Lariviere, 1999); quantity flexibility contracts (Tsay, 1999); target-level sales rebates (Taylor, 2002) and so forth have been studied as tools for supply chain coordination. There are rich literatures on supply chain coordination with revenue-sharing and whole sale price discount contracts. Gerchak and Wang (2004) have investigated two very distinct types of arrangements between a retailer and its suppliers. They have explored the resultant equilibrium in components delivery quantities in the decentralized supply chain, and its implications for participants and systems expected profits. Cachon and Lariviere (2005) have found that revenue-sharing is equivalent to buy-backs in the news-vendor case and concluded that revenue-sharing well coordinates a supply chain with retailers competing in terms of sales volumes. Veen and Venugopal (2005) have illustrated that revenue-sharing contract optimizes the chain and delivers a win–win situation for all the players in a video retail supply chain. Yao et al. (2008a,b) have argued that revenue-sharing contract improves supply chain performance. Linh and Hong (2009) have studied channel coordination through a revenue-sharing contract between a single retailer and a single supplier in a two-period newsboy problem and concluded that wholesale prices should be set lower than retail prices and the optimal revenue-sharing ratio should be increased linearly. Monahan (1984) has studied the use of all-unit quantity discount schedules to increase the order size in a two stage supply chain under the classical EOQ framework. Lee and Rosenblatt (1986) have extended the model by relaxing the lot-for-lot production assumption and imposing constraints on the price discount to remain below the selling price. Weng (1995) has showed that whole sale price discount does not provide coordination when demand is price-sensitive and transaction costs are functions of order quantities. The author has suggested the use of franchise fee and quantity discount simultaneously to restore coordination. Further, Wang and Wang (2005) have provided a generalized news-vendor model to use discount decisions as incentive policy to coordinate the supply chain.

But to the best of author's knowledge no one uses revenue sharing coupled with rebate as a tool for supply chain coordination. Again most of the cited papers consider only the effect of price, but it is also observed that the demand is not only dependent on price of the product but also on effort of the manufacturer. It is quite common in practice; the manufacturer applies selling effort to develop the market for the product such as stipulation of product information in market, advertisement, expenditure on social activities, greening effort, free repair or after-sales service. Coexistence of above factors is common in most of the retail sectors as stipulation of high effort to improve market demand. But a higher effort level sustains more cost to the individual paying such effort. From the above literature, it is also observed that consequence of supply chain coordination as well as influence of manufacturer's extra marketing efforts are overlooked.

Although use of rebate, thereby effects of these for individual benefit are studied extensively under a variety of modeling assumptions, none has discussed effects of rebate promotion and supply chain coordination simultaneously under manufacturer sales effort. We examine and compare three different coordination contracting approaches, DR&RS", "DDR" and "DR&ES". The effectiveness of the contracting approach is verified with respect to supply chain coordination perspective. In "DR&RS", the manufacturer offers customer rebate to the end customer and retailer compensates manufacturers loss by sharing a percentage of her revenue with manufacturer. In "DDR" manufacturer provides retailer rebate by reducing her wholesale price and as a consequence retailer also reduces her price to enhance demand of the product. In "DR&ES", the manufacturer offers customer rebate to the end customer and each member in supply chain wants to promote the product by providing promotional effort. The purpose of the paper is to examine coordination of the supply chain when these coordination mechanisms are used. We have verified analytically that all the proposed coordination mechanisms can coordinate the system for linear demand. But for iso-elastic demand, DR&RS and DDR coordinate the system but DR&ES does not. Effectiveness, flexibility, equivalence and preference of proposed mechanism are discussed analytically. The rest of this paper is organized as follows: The model is formally developed for decentralized and integrated decision making in Section 2 and then coordination of the chain is analyzed under linear and iso-elastic demand. A final discussion, in Section 3, provides some comments on the main results obtained, on the shortcomings of the model and some suggestions for future research. The proofs are reported in the appendices.

2. The model

We consider a stylized distribution channel with a manufacturer who sells a single product to maximize her total profit. The manufacturer supplies a single downstream firm, the retailer. We assume that the manufacturer can drive the channel behavior by offering rebate. The manufacturer's objective is to increase sales motivation of the retailer and to induce end customer. Moreover we assume retailer also transfers a part of the rebate to the consumer by selling at a reduced price and this increases sales too. A price discount thus, affects both consumer's demand and retailers sales motivation. In addition, manufacturer can influence the demand through her promotional/selling effort e. Several authors have established that some of the main results and conclusions in the analysis of supply chain may be affected by the choice of the demand model and results are also sensitive (Jeuland and Shugan (1988), Granot and Yin (2007)). Since linear and iso-elastic (with out effort) demand are two most common demand functions used in the operations management and economics literature, in this paper we examine the effect of proposed coordination policies for both types of demand. Demand is assumed to be the function of retailer's retail price p_r and effort e provided by manufacturer. The functional form of demand is