

Chapter XII

Coordination of a Supply Chain with Satisficing Objectives Using Contracts

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ABSTRACT

Setting performance targets and managing to achieve them is fundamental to business success. As a result, it is common for managers to adopt a satisficing objective—that is, to maximize the probability of achieving some preset target profit level. This is especially true when companies are increasingly engaged in short-term relationships enabled by electronic commerce. In this chapter, our main focus is a decentralized supply chain consisting of a supplier and a retailer, both with the satisficing objective. The supply chain is examined under three types of commonly used contracts: wholesale price, buy back, and quantity flexibility contracts. Because a coordinating contract has to be Pareto optimal regardless of the bargaining powers among the agents, we first identify the Pareto-optimal contract(s) for each contractual form. Second, we identify the contractual forms that are capable of coordination of the supply chain with the satisficing objectives. In contrast to the well-known results for the supply chain with the objectives of expected profit maximization, we show that wholesale price contracts can coordinate the supply chain with the satisficing objectives, whereas buy back contracts cannot. Furthermore, quantity flexibility contracts have to degenerate into wholesale price contracts to coordinate the supply chain. This provides an important justification for the popularity of wholesale price contracts besides their simplicities and lower administration costs. Finally, we discuss possible extensions to the model by considering different types of objectives for different agents.

INTRODUCTION

The decentralized supply chain has been a major research issue in supply chain management. In particular, an important research stream has focused on the supply chain coordination with contracts. Without coordination, each agent in a decentralized supply chain tends to make decisions for his own objective instead of the interest of the whole chain. To improve the overall performance of the chain, it is necessary to have some mechanism so that each agent's interest is aligned with the interest of the whole chain. Such an alignment could be achieved through appropriately designed contracts, which provide incentives for the agents in the chain to coordinate through profit allocation and sharing.

Much of the research has assumed that each agent in a supply chain is risk-neutral and his objective is to maximize (minimize) the expected profit (cost). Under this assumption, a supply chain is said to be coordinated when the summation of individual expected profits (costs) are maximized (minimized). A number of contractual forms have been studied recently under the risk-neutral assumption. These include the three popular contracts: wholesale price (WP) contracts (Lariviere & Porteus, 2001; Corbett et al., 2004), buy back (BB) contracts (Pasternack, 1985), and quantity flexibility (QF) contracts (Tsay, 1999; Cachon, 2003).

With a WP contract, the supplier charges a constant unit wholesale price to the retailer. With a BB contract, the supplier charges a constant unit wholesale price, but offers the retailer a partial refund for all of the unsold units. With a QF contract, the supplier charges the retailer a constant unit wholesale price, but offers the retailer the flexibility of adjusting the initial order quantity without any penalty. For the one-period setting where a risk-neutral supplier sells to a risk-neutral retailer, it has been shown that BB and QF contracts are capable of supply chain coordinating. However, it is well known that WP contracts are incapable of coordinating the channel due to the phenomena of double marginalization (Spengler, 1950).

With the increasingly popular use of electronic commerce, suppliers and retailers are increasingly engaged in short-term relationships. For example, in addition to their traditional long-term procurement contracts, more and more companies have gone to spot markets for procurement and/or disposal of excess inventory (Johnson & Klassen, 2005). Therefore, it is fair to say that agents in supply chains are increasingly risk-averse, instead of risk-neutral and adopting the objective of expected profit maximization, which is more appropriate for long-term relationship. To operationalize risk-aversion, an important approach is the mean-variance analysis (Markowitz, 1959). This approach works the best when the random variable under consideration is close to being symmetrically distributed, which, however, may not be the case for many inventory and supply chain management problems. Without a relatively symmetrical distribution, it is better to operationalize risk-aversion using different measures of downside risk. These measures include semi-variance and critical probability. With semi-variance, one is concerned with the volatility of the outcomes below the mean. With critical probability, one is concerned with the probability of the outcomes in some critical region. In this chapter, we choose to operationalize risk-aversion as the critical probability of achieving some predetermined target profit.

Setting performance targets and managing to achieve them is fundamental to business success. Targets provide explicit directions to an organization and motivate management to strive for even higher levels of performance. However, target setting is both an art and a science. Too high a target will provoke frustration and cynicism, whereas too low a target will engender apathy and risk the organization's survival. Different methods of target setting have been practiced by many decision makers. In the approximate order of most to least used, they include plucking it out of thin air, a percentage improvement on last period, and benchmarking (Barr, 2003). For example, Jack Welch describes the setting of stretch targets as

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