

# Chapter 18

## Revenue Sharing in a Two-Stage Supply Chain with Linear Stepwise Unit Inventory Holding Cost

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### ABSTRACT

*In this chapter we focus on examining the coordination mechanisms for a two-stage supply chain comprising one supplier and one retailer. We consider such a channel relationship that the transaction quantity between the two members is sensitive to the supplier's inventory level and that the supplier's unit inventory holding cost has a linear stepwise structure. We devise a coordinated revenue-sharing contract with bargaining so that each party's respective profit is better than that resulted from the simple sequential optimization mechanism. The key contract parameters, namely the supplier's inventory level and the retailer's revenue-sharing fraction, are obtained and analyzed. Numerical illustrations of the contracts are given and shed lights on how the supply chain should coordinate in order to gain better performance.*

### INTRODUCTION

A supply chain is a complex network consisting of multiple inter-dependent members that often have conflicting goals and objectives. As such, to

improve a supply-chain wide performance and to achieve a win-win, mutually beneficial outcome, coordination mechanisms are imperative and valuable. It has been proven in the literature that supply contracts provide an effective vehicle to achieve coordination, which leads to an increased profit of not only the entire chain but of each

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chain member as well (e.g., Tsay, Nahmias & Agrawal, 1999; Cachon, 2003). In addition to serving a coordination vehicle between related parties, a contract specifies the courses of actions the involved parties should take and outlines the responsibilities of each member. As the role of supply contracts is increasingly important, how to design an effective contract has received immense attention from the supply chain management professionals over the past decade.

Commonly used supply contracts have multiple formats, including buy back, quantity flexibility, revenue sharing and sales rebate contracts – to name a few (Simchi-Levi, Kampski & Simchi-Levi, 2004; Bose & Anand, 2007). These contracts differ on the basis of the contractual clauses between buyers and suppliers and primarily concern quantity, time, quality, and price. Of the existing contract models, revenue-sharing contract is relatively simple for design and administration and has been studied widely in recent years. When applied to a two-stage supply chain consisting of a single manufacturer (or supplier) and a single retailer, the revenue-sharing contract aims to align the two parties' interests and courses of actions with the supply chain system's objectives by having the retailer share a portion of its revenue with the supplier. As a result, the supplier's willingness to cooperate would increase, thereby improving the supply-chain wide performance as well as each party's resulted benefit.

Coordination through a revenue-sharing contract is a valuable supply chain management strategy and applicable in a wide range of situations. One key issue in designing the contract is to determine the revenue-sharing fraction for bigger coordination possibilities as well as for higher levels of profit. Addressing this issue can be accomplished in various contexts of supply-chain configurations. In this paper, we consider such a supply chain that the transaction volumes depend upon the supplier's inventory level and that the supplier's unit inventory holding cost has a linear step-wise structure. This type of channel

relationship is suitable for numerous kinds of supply chains, such as those for daily required merchandise, consumer products and industrial commodities, all of which usually have large and steady demands that increase with the availability of the products. With respect to a supplier's unit inventory holding cost, since the supplier rents or uses a warehouse space that may vary, the cost may not stay constant as what is often assumed in the literature; rather, it may possess a stepwise structure (e.g., Bayındır, Birbil & Frenk, 2007).

We examine the coordination effectiveness of the revenue-sharing contract in the supply chain described above. In particular, we analyze the feasibility of coordination in such a revenue-sharing contract that through bargaining and mutual agreement, the retailer would offer a higher share of revenue and the supplier would have sufficient incentive to choose a higher inventory quantity, thereby improving both parties' profits. We obtain the solutions of the two contract parameters, namely the retailer's revenue-sharing fraction range and the supplier's inventory volume. Numerical examples that we have conducted indicate that significant improvements can be accomplished by the proposed contracts.

The remainder of the paper is organized as follows. Section 2 summarizes the literature related to revenue-sharing contracts. In Section 3, we obtain results from basic centralized and sequential optimization mechanisms, which will be used as a basis for subsequent analysis and comparison. Section 4 considers how to better coordinate the two parties through revenue sharing and bargaining. The range of the revenue-sharing fraction for bargaining as well as the desired inventory level is derived. In Section 5, we provide numerical examples to demonstrate the effectiveness of the revenue-sharing contracts. Finally, concluding remarks and directions for future research are given in Section 6.

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