

Essays on Supply Chain Coordination

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In this dissertation we look at three separate but interconnected streams on supply chain coordination with contracts. The three streams are organised as four essays. In the first essay we analyze a clearance sale inventory model where unlike in the newsvendor problem the leftover inventory is cleared at a clearance price that is a function of the leftover quantity. In the second essay we study the supply contracts for a clearance sale inventory model. In the third essay we look at a single supplier multiple buyer network and try to understand the influence of market share, structure and asymmetric information on supply contracts. Finally in the fourth essay we look into the option contract mechanism for coordination of a single supplier multiple buyer supply chain.

The first essay is motivated by the increasing trend in retail markdowns over the past few decades. It indicates that over orders and high clearance inventory are becoming a common phenomenon in retailing. When the clearance inventory is high there are many situations wherein the marginal revenue as result of reducing the clearance price below a particular level is negative. In such situations, the retailer is better off clearing only part of the leftover inventory and disposing the remaining for free. In the first essay, we show that the newsvendor model is not appropriate for this problem as it is limited by the assumption that the entire end of season inventory is cleared at a fixed salvage value. We model the clearance sale inventory problem for determining the optimal order quantity. We analytically prove that the newsvendor model results in over orders and profit loss compared to our model.

In the second essay we use the clearance sale inventory model and establish the coordination mechanism for wholesale price, buy-back, revenue sharing and sales rebate contracts. Through numerical analysis we illustrate the differences between the two models for the supply contracts considered. The conditions under which the variance in performance between our model and the classical newsvendor model is significant are also determined.

Supply contracts have been studied extensively both in the context of dyadic and network structures; the influence of market share of buyer on the choice of contracts has not received sufficient attention. In the third essay, we focus on this gap and examine a network consisting of one supplier and two buyers under various supply chain structures – complete and partial decentralization. In the complete decentralized setting both buyers are independent of the supplier. In the partial decentralized setting the supplier and one of the buyers form a vertically integrated entity. Both buyers order from the single supplier and produce similar products to sell in the same market. The supplier charges the buyer based on a contract and the transfer price varies depending on the supply chain structure. We investigate the influence of supply chain structure, market-share and asymmetry of information on supplier's choice of contracts. We discuss four types of contracts – wholesale price, quantity-discount, linear two-part, and nonlinear two-part tariff contracts. We determine the cut-off policy by incorporating the reservation profit level of individual buyers.

In the fourth essay we revisit the supply chain network, consisting of a common supplier and multiple downstream retailers. Such network often faces channel conflict due to both price and inventory competition and in this context wholesale price contract fails to coordinate the channel and leads to conflicts of interest between supplier and retailers. In this essay, we establish that in the presence of option contract a pure strategy unique Nash equilibrium exists

for the retailer game. Through option mechanism, the supplier can coordinate the entire supply chain system to achieve the best performance, in the presence of retailer competition in both price and inventory. We demonstrate that option contract provides the supplier with better flexibility in terms of profit allocation compared to other channel coordinating contract like buyback. We also calculate the limitation of this contract form and show that this contract form can only achieve coordination with a limited number of retailers.