

Chapter 1

Coordination of a Supply Chain with Demand Stimulation and Random Demand Disruption

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ABSTRACT

This chapter develops a dynamic game model of a supply chain consisting of one manufacturer and one retailer to study the coordination mechanism and the effect of demand disruption on the coordination mechanism, where the market demand is sensitive to retail price and service. We assume that the supplier and the retailer only know the distribution of the disrupted amount after the demand disruption and they share the quantity deviation costs. We find that an all-unit wholesale quantity discount-subsidy mechanism can coordinate the supply chain. We give the coordination mechanism of the supply chain after the demand disruption and find that the demand disruption remarkably influences the price-service level decisions of the centralized supply chain and the coordination mechanism of the decentralized supply chain. In particular, the expected quantity differs from the planned quantity although the penalty costs prevent from this deviation.

INTRODUCTION

In reality, besides price, service level also influences the market demand for one product. Good service will stimulate customers to buy more products and bad service will discourage custom-

ers. However, providing the better service needs a higher service cost. A supply chain should jointly determine retail price and service level to maximize its channel profit. In a decentralized supply chain, the retailer determines retail price and service level independently, which results in the decisions different from that of the centralized supply chain due to double marginalization. Thus,

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a mechanism should be designed to coordinate the supply chain. The decisions and coordination mechanism are further complicated by the potential demand disruption.

Between the drafting of the production plan and its execution, there may be some occasional events such as international terrorism, natural disasters like SARS, earthquake and storms, economic crises, and rumour of the goods shortage, which will result in demand disruption. For example, after 5-12 earthquake in Wenchuan, China, the demands for tabernacle, respirator, medicine and foodstuff increase suddenly. Thus, the members of supply chain should adjust their decisions to react the demand disruption. However, adjusting decisions (quantity) will incur a deviation cost for them. This chapter will incorporate the quantity deviation costs into their objectives.

In this chapter, we develop a dynamic game model of a supply chain consisting of one supplier and one retailer to investigate how the random demand disruption affects the price-service decisions and coordination mechanism. We assume that the supplier shares the quantity deviation cost with the retailer and the supplier designs an all-unit wholesale quantity discount-subsidy mechanism to coordinate the supply chain. We find that the supply chain can be coordinated by the mechanism, i.e., the mechanism induces the retailer offers the optimal retail price and service level of the centralized supply chain, where the channel profit is maximized. The demand disruption, the demand sensitivity to retail price and the service cost efficiency remarkably influences the coordination mechanism; and the expected quantity after demand disruption deviates from the planned quantity even the disrupted amount is very small, which differs from those of Qi et al. (2004) and Xiao et al. (2007).

The rest of this chapter is organized as follows. We reviews related literature, presents a basic model, study the coordination of supply chain in the normal demand environment, and then explores the coordination mechanism of supply

chain after the demand disruption. After providing a numerical example for additional insights, we conclude with a summary and directions for future research.

LITERATURE REVIEW

This chapter is closely related to price and service decisions, supply chain coordination management and disruption management. When customers buy goods, they focus on not only price, but also service level. Thus, the firms should jointly determine retail price and service level to maximize their profits. Tsay and Agrawal (2000) study coordination strategies when the retailers use price as well as service to directly compete for end customers. Gilbert and Cvsa (2003) examine the trade-off that is faced when a firm's channel partner has opportunities to invest in either innovation of cost reduction or quality improvement, i.e., demand enhancement. Raju and Zhang (2005) consider the price-service decisions of the dominant retailer, where the competitive fringe is a price follower and cannot provide service. Xiao and Yang (2008) study the price-service competition between two channels, where each chain consists of one supplier and one retailer. In our model, the retailer jointly determines its price and service decisions.

The coordination management literature focused on how to design a mechanism that induces the supply chain's members act as a centralized decision maker, which will result in a maximum channel profit. Jeuland and Shugan (1983) explore the problem of channel coordination of a simply supply chain and derived the form of the quantity discount schedule that results in optimum channel profits (Moorthy, 1987; Jeuland and Shugan, 1988). Weng (1995) investigates the coordination of a supply chain consisting of one supplier and one buyer who jointly determines selling price and order quantity and found that the optimal all-unit quantity discount policy is equivalent to the optimal incremental quantity discount policy

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