

Chapter 64

Coordinate the Express Delivery Supply Chain with Option Contracts

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ABSTRACT

In this paper, the authors study the capacity decision problem in an express delivery supply chain consisting of an online retailer and an express delivery provider where products sold by the online retailer are delivered by the express delivery provider to end customers. Unlike the case of the traditional manufacturer-retailer channels, the delivery capacity is a kind of “service product” that cannot be inventoried. To avoid the risk of unprofitable capacity, the delivery provider tends to build a limited delivery capacity which is smaller than the system-wide optimal capacity. To solve such a problem, the authors investigate the capacity coordination issue in this service supply chain using option contracts. By allowing the online retailer to reserve the capacity in advance, the delivery provider could rent a part of capacity which surpasses its self-owned capacity from a third party logistics. It is demonstrated that, compared with the benchmark based on a newsvendor model, option contracts can coordinate the delivery service supply chain. The authors also figure out the feasible option contracts that improve member’s expected profit and show the degree of improvement that could be achieved.

INTRODUCTION

An increasing number of customers are interested in purchasing products online instead of through traditional retail outlets, which causes significant volumes of delivery services. A few researchers have studied the relationship between the express delivery service and customer’s satisfaction under the e-commerce environment (Ryan & Valverde, 2005; Agatz, Fleischmann, & Van Nunen, 2008; Rao, Goldsby,

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Griffis, & Iyengar, 2011). Previous researches find that poor express delivery service has a bad impact on consumers' utilities and leaves consumers disappointed at the online shopping experience and, as a result, hinders the growth of e-commerce.

Among various problems of a poor express delivery supply chain, 'Out of Capacity' is one of the most important problems confronted by delivery service providers during online hot selling periods. For example, during the Singles Day selling season in China, most online retailers sell the products at 50% off the regular price, which causes a surge of online shopping. It is reported that, just in 2015, the Chinese e-commerce giant Alibaba's Singles Day's sale is up to \$13.87 billion. When enormous online orders are concentrated in a short time, it far exceeds the capacity of express delivery providers and arouses various delivery problems. Such as, orders are delayed, damaged, lost and as a result, cancelled with consumer complaints. The poor delivery service leaves consumers with bad experiences and decreases their purchasing intentions, which eventually hurts e-retailers' profits (Zhou, 2013; Zhang, Gou, Yang, & Liang, 2015). Hence, it is necessary to solve the overloading problem during specific periods in an express delivery supply chain.

The express delivery supply chain differs from the traditional inventory supply chain in that it is a new mode of service supply chain, which not only includes the flow of physical goods, but also includes the flow of delivery service. Delivery service is a kind of "service product" that cannot be inventoried. That is, delivery capacity has no salvage value and a delivery service provider cannot store his today's unused capacity for tomorrow. Therefore, express companies show their great caution in building delivery capacity to avoid over-investment, which may lead to a shortage of delivery capacity. In this case, the double marginalization will be amplified by random market demand (Spengler, 1950).

To investigate the capacity decision problem in the express industry, we consider an express delivery supply chain consisting of a single online retailer and a single delivery service provider. On the basis of a newsvendor model, we derive the delivery service provider's optimal delivery capacity, which is shown to be smaller than the system-wide optimal capacity. In this case, the supply chain coordination cannot be achieved. Therefore, a major challenge faced by the delivery provider and the retailer is how to increase their own expected profits and improve the delivery supply chain's performance through acceptable coordination mechanisms to cope with demand uncertainty.

Accordingly, interesting problems occur here including the following: (i) How to improve the express delivery supply chain's performance through coordination contracts? (ii) Among the coordination contracts, what are feasible contracts that could be accepted by two supply chain members? (iii) What degree of improvement of member's expected profit could be achieved through the acceptable coordination contracts?

The main contribution of this paper is that we introduce a set of option contracts between the delivery provider and the online retailer in the express industry. We take the delivery capacity as the coordinating target to solve the mismatch problem between the supply and the demand caused by the random market demand. By reallocating the risk between two supply chain members, the supply chain coordination is achieved and supply chain efficiency is improved. In this paper, we focus on how option contracts can coordinate the express delivery supply chain by yielding the system-optimal capacity decision and investigate how much improvement of agent's expected profit could be obtained with the acceptable options.

The rest of this paper is arranged as follows. Section 2 briefly reviews the related literatures. In section 3, we present the notations used in this paper and a detailed description of our model. In section 4, two cases of benchmark models are provided first and then the express delivery supply chain model with the option contracts is investigated. In section 5, numerical analysis is conducted to validate the results

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