

ABSTRACT

Title of the Thesis: Studies on Some Green Supply Chain Problems: Model Development and Analysis

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Green supply chain management (GSCM) is a topic that has evolved over the last couple of decades as a flourishing sub-region of supply chain management (SCM) and getting a rising consideration from both academics and practitioners. During this time, GSCM has become a famous methodology for few manufacturing firms to acquire financial advantages by lessening environmental contamination while controlling environmental damages. For lessening environmental contamination, manufacturing firms have to utilize modern advanced technologies that desire additional investments. Again, for moderating environmental damages, appropriate reverse channels need to be selected to acquire enough end-of-life products. So, various new controversies have been uncovered regarding the implementation of this methodology, which raises doubts as to whether adopting the GSCM planning will upgrade environmental safety and finally lead to progressed profitability. Endeavoring to comprehend these intricacies is vital and of importance from both empirical and academic viewpoint. This doctoral thesis aims to develop various GSCM models and analyses those models with a focus on improving economic as well as environmental performance. It consists of eight chapters. In Chapter 1, a brief overview and fundamental concepts of GSCM, various terminologies relevant to the thesis are provided. This chapter ends with the significance and organization of the thesis. Chapter 2 provides a brief background of the literature used in this study.

The third chapter considers the manufacturer's green innovation under warranty period as a first step in investigating whether execution of GSCM practices has a positive effect on the profitability of channel members. It presents two game-theoretic models depending on demand dependency of greening level of the product. During the warranty period, a portion of returned items is refurbished and sent back to customers while the remaining portion is remanufactured and sold in the secondary market, and the same portion is replaced by the new products. Both the models are solved under centralized and decentralized policies, and revenue sharing contract. Through analytic and numerical analyses, it is seen that although additional investment is required for green innovation, it leads the supply chain to improved environmental progress and economic prosperity.

In addition to green innovation, since the collection of used products also improves the environmental performance, we discuss various strategies utilized in used products collection in Chapter 4 which consists of two parts. The market demand in both parts is assumed to be dependent on the selling price, greening level and marketing effort. The first part presents a two-period closed-loop green supply chain model to investigate the impact of green innovation, marketing effort and collection rate on the supply chain decisions. In the first period, the manufacturer produces new product from fresh raw materials while in the second period, besides manufacturing new products, he also collects and remanufactures used products. The centralized model and three decentralized models (depending on whether the manufacturer or the retailer or both collect used products) are considered. A cost sharing contract is also employed to address the coordination issue. It is observed that the supply chain gives better response when both the manufacturer and the retailer collect used products simultaneously, and the performance of the supply chain can be improved by instigating either green innovation or marketing effort or both. The second part of this chapter investigates the effect of used product collection through the third-party as well as the manufacturer and the retailer under the retailer's fairness concern. It develops the centralized model and six decentralized models depending on the retailer's

fairness behavior and/or product recycling options. Here, a restitution-based wholesale price contract is developed to resolve the channel conflicts. The derived results reveal that the fairness behavior and transfer price play important role in deciding appropriate reverse channel for collecting used products.

Product sale through the retailer may be affected by double-marginalization effect which can increase the product price, resulting in the loss of channel members' income. Due to rapid growth of online business, both the product sale and used products collection through the e-tail channel are excellent decisions to adapt up to the channel individuals' trepidation of losing profits due to green innovation. Chapter 5 deals with this issue by considering both forward and reverse dual-channels and develops various models under different channel powers of the channel individuals. Numerical results indicate that the inclusion of e-tail channel together with the retail channel improves channel performance; selling prices in the retail and e-tail channels depend on customers' loyalty to those channels.

When a manufacturer starts producing green product, its competition with traditional non-green product is inevitable. Again, when multiple retailers sell those products, there is also a competition between them. So, an immediate question may arise – how do competing manufacturers and competing retailers behave while making their decisions? In seeking the answer to this question, Chapter 6 assesses cooperative and non-cooperative behaviors of the same level players under government sponsorship. The first part of Chapter 6 describes the issue of competition between a traditional manufacturer and a green manufacturer for marketing substitutable products. It considers various problem scenarios viz. centralized, Nash game, and manufacturer-led Stackelberg game. Cost sharing and revenue sharing under cost sharing contracts are executed to expand the greening level of the supply chain. While the second part analyses retailers' competition and cooperation under cap-and-trade policy. It also develops the centralized model and three manufacturer-led decentralized models viz. Collusion, Cournot (Nash), and Stackelberg depending on different competitive behaviors of the retailers. A transfer payment mechanism is developed so that all the channel members achieve Pareto improvement. In both parts, numerical results explore that the cooperative behavior (Collusion) can provide better outcome to any one of the individuals only but their competing behavior (Nash) is profitable for the majority of the individuals; the government subsidy can effectively expand the sales volume by enhancing product's greening level.


So far we have focused on economic performance as well as environmental sustainability, but the global covid epidemic and lockdown have shown us how important it is to emphasize social performance. In this regard, Chapter 7 extends the boundary of GSCM to a sustainable supply chain management by integrating CSR. The first part of this chapter discusses various used products collection options through single channel with retailer's CSR effort and government sponsorship, whilst the second part deals with recycling competition and CSR investments of both the manufacturer and the retailer. In order to address the channel coordination issue, a two-part tariff contract is considered in the first part while a joint revenue-and-cost sharing contract is proposed in the second part. Analytical and numerical comparison indicate that CSR effort is able to improve channel efficiency significantly; the manufacturer prefers to collect used products and never contracts with the TPC for this purpose in case of single collection but, in case of collection competition, the competition coefficient determines whether the manufacturer himself procures with the retailer or outsource it to the TPC. In both parts, the proposed contract can coordinate the supply chain and provide more profit to both the manufacturer and the retailer than their decentralized profits.

Chapter 8 provides an overall conclusion of the study, recommends some insights for business managers and outlines scopes for further research.


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