

Modeling and analyzing pricing and inventory problem in a closed-loop supply chain with return policy and multiple manufacturers and multiple sales channels using game theory

L. Nazaria¹, [Mehdi Seifbarghy](#)² and M. Setak³

¹ Department of Industrial Engineering, Science and Research Branch, Islamic Azad University, Tehran, Iran.

² Department of Industrial Engineering, Alzahra University, Tehran, Iran.

³ Department of Industrial Engineering, K.N. Toosi University of Technology, Tehran, Iran.

Abstract

This paper focuses on determining ordering and pricing policies in a single-period closed-loop supply chain. The assumed supply chain includes a number of manufacturers who provide their different, yet substitutable, products for their customers via a common retailer; however, manufacturers can have their own internet-based sales channels in order to provide products for the customers. The customers can return products if they are not satisfied with them. The returned products are collected in a repair center, repaired, and sold as second-hand products through the retailer's channel or through an internet-based sale channel. The customer demand is assumed to be stochastic. This study aims to determine the optimum prices for the internet-based and retailer's sales channels for the initial and second-hand products. It also tries to determine the optimal values of retailer order and production rates of manufacturers and repair centers. Three types of game strategies for the supply chain, including Nash, Stackelberg game with a retailer as the leader, and Stackelberg game with manufacturers and repair center as the leaders, are studied in a decentralized condition. The analytical equilibrium solutions, equations, and constraints are extracted for these strategies. Finally, the effect of variations in key parameter is investigated.

Keywords: Pricing, Inventory, Closed loop supply, chain, Game theory, Substitutable product, Repair center.