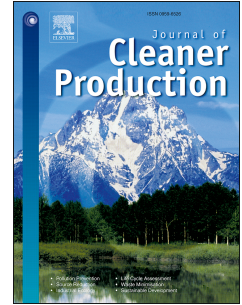


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Pricing decision of a two-echelon supply chain with one supplier and two retailers under a carbon cap regulation

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Abstract

This study considers a two-echelon make-to-order supply chain consisting of one supplier and two retailers under carbon cap regulation. We analyze the pricing decision process in a decentralized system from a game theoretical perspective and find the optimal pricing strategy for the wholesale prices of the supplier and the retail prices of two retailers. Our framework involves various operational strategies, including consistent and inconsistent wholesale prices for the supplier and consistent and inconsistent retail prices for the two retailers. We analyze and compare the performance of strategy combinations and find that the combination of a consistent wholesale price and an inconsistent retail price with a transfer payment mechanism is the best pricing decision to achieve Pareto improvement for supply chain members. We also provide the appropriate range of a carbon cap for the policy maker to effectively reduce carbon emissions. Finally, several numerical examples illustrate the impacts of a carbon cap on profits and carbon emissions in different pricing models.

Keywords: supply chain, carbon emission capacity, Stackelberg game, pricing decision

1. Introduction

Over the past few decades, the greenhouse effect and global warming have attracted increasingly wide attention. In 1995, the Intergovernmental Panel on Climate Change (IPCC) pointed out that the rise in the earth surface temperature was caused mainly by the increase of greenhouse gas (GHG) concentrations in the atmosphere (IPCC, 1995). In other words, it is generally believed that one of the main driving forces of global warming is the increase of GHG (e.g., carbon emissions). Supply chain activities are major source of GHG emissions such as carbon dioxide. Today, it is recognized that only by sharply reducing carbon emissions will the greenhouse effect be gradually slowed down (Houghton et al., 1996). With a low carbon economy becoming a new trend worldwide, consumers are more sensitive to low carbon products due to the increasing awareness of environmental problems. Therefore, supply chain operations optimization considering the carbon footprint is a significant research field.

Global warming, the popularity of a low-carbon economy in international society, and increased public awareness about environmental issues are encouraging regions and countries to reduce carbon emissions. The IPCC proposed that we should achieve at least a 50% reduction in global carbon emissions by 2050 (Parry et al., 2007). In 1997, 37 European Union members and industrialized countries signed the Kyoto Protocol, which defined the carbon emission reduction obligations of developed countries and required many of the gathered countries to focus on GHG emission abatement. As of May 2008, 181 countries have accepted the protocol. On April 22, 2016, the Paris Agreement, which made arrangements for global action on climate after 2020, was signed by 175 countries on the first day of open signing. The agreement promised to contain the global temperature increase in the range of 2°C. Ban Ki-moon called on governments and all sectors of society to fully implement the Paris Agreement and take immediate actions to reduce GHG emissions. For the purpose of environmental protection, countries have increasingly begun to focus

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