



# Manufacturer and retailer coordination for environmental and economic competitiveness: A power perspective



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## ABSTRACT

This study examines the role of power relationship and coordination in sustainable supply chain management. We investigate a two-echelon supply chain that consists of a manufacturer and a retailer whose Customer demand is carbon emission sensitive. Using the game-theoretic approach, we compare the equilibrium solutions under three supply chain power structures to analyse the effects of power relationship on supply chain decisions and sustainability performance. A two-part tariff contract is designed to coordinate the supply chain. The findings provide important managerial insights that can help firms develop a better understanding of power relationship and coordination in achieving sustainability goals.

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## 1. Introduction

In the era of climate change, firms are exerted increasing pressure to reduce carbon emissions while maintain their economic competitiveness. However, the notion of “boundaryless responsibility” (Amaeshi et al., 2008) means that firms need to consider how they can achieve economic, environmental, and social objectives of the sustainability throughout their entire supply chain. It is important for them to look beyond their organizational boundaries and develop a more holistic solution for a sustainable supply chain. Sustainable supply chain management would require efforts from all segments of the supply chain. However, there are often conflicting interests between individual supply chain members such as tension between a manufacturer and a retailer considered in this study. In the UK and France, we have witnessed some high profile protests against major supermarket chains by the dairy farmers because of cheap prices of milk. Despite Apple’s promise, published in annual Supplier Responsibility Report to improve working conditions and preserve the environment, some of the technology giant’s suppliers are on the news headlines being accused over worker exploitation. Moreover, the UK government requires firms to measure and to report their annual greenhouse gas emissions of their own operations, and furthermore, it is also anticipated that companies will be required to report carbon footprint of upstream supply chain activities that are beyond a reporting firm’s direct control.

Sustainable supply chain management requires a coordinated effort from all parties to achieve the sustainability objectives. Such an effort may be hampered by the trade-offs between different sustainability objectives and tensions between supply chain members. Furthermore, the power relationship between supply chain partners makes the coordina-

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tion of a sustainable supply chain even more complicated. Referring to resource-dependence perspective, power depends on the criticality of the commercial and operational resources and the availability of alternatives for sourcing the same resource (Cox et al., 2002; Touboulic et al., 2014). Touboulic et al. (2014) shows the influences of power on how supply chain members manage their relationships and its effect of organizational response to the sustainability implementation. It is critical that power structures that exist in the supply chains are properly understood by managers in order to manage supply chains strategically and operationally (Cox, 1999). Very little effort has been made in the existing literature to explore the issue of coordinating the sustainable supply chain with the consideration of power relationship. This study is going to fill this gap in the literature by addressing the following research questions:

- (1) Should the supply chain members work on sustainability initiatives independently or coordinate their sustainability effort?
- (2) If yes, how should members coordinate with each other to achieve economic and environmental competitiveness?
- (3) What is the impact of supply chain power relationship on the coordination decisions and sustainability performances?

In order to answer these questions, a two-echelon supply chain is considered. It consists of a manufacturer and a retailer who purchases products from the manufacturer and sell them to end consumers. To take economic and environmental performances into consideration, the consumer demand faced by the retailer is assumed to be carbon emissions sensitive, as well as price sensitive. Based on game models, the manufacturer's optimal wholesale price and unit carbon emissions, and the retailer's optimal retail price are derived under three different supply chain power structures, that is, the equilibria of the manufacturer Stackelberg, vertical Nash and retailer Stackelberg, respectively. Through a comparison of the derived results from three power structures, we analyse the effect of the supply chain power relationship on operations decisions, coordination contracts, and sustainability performances. The main contributions of our work are as follows:

First, the notions of supply chain coordination (Simpson and Power, 2005; Vachon and Klassen, 2008; Swami and Shah, 2013) and supply chain power relationship (Simpson et al., 2007; Pagell et al., 2010; Touboulic et al., 2014) have been recognised to play important roles in sustainable supply chain management by the existing literature. Achieving the economic and environmental sustainability requires a coordinated effort from the involved supply chain members (Swami and Shah, 2013), and such an effort may be hampered by the power relationship in supply chains (Touboulic et al., 2014). Nevertheless, few studies have been brought the two important issues together to systematically examine their impact on accomplishing the economic and environmental competitiveness. To the best of our knowledge, this paper is the first attempt to explore this research avenue. The research findings derived from such an investigation will help firms seek optimal solutions based on their supply chain environments to improve the sustainability performances.

Second, more and more firms view the carbon emission reduction as a competitive strategy to win customer demand because of the increasing customer environmental consciousness (Liu et al., 2012; Kanchanapibul et al., 2014; Zhang et al., 2015). We consider a demand function that is both price and carbon emissions sensitive and use the carbon emission attribute as a decision variable rather than a constraint, which complements to the existing low carbon supply chain literature that often uses the carbon emissions attribute as a constraint or considers the demand of single manufacturer (Nouira et al., 2014; Du et al., 2015).

Third, this research also makes important practical and policy contributions. Through the systematic analysis of optimal wholesale prices, retail prices, unit carbon emissions, and tariff contracts under different supply chain power structures, our findings provide valuable managerial implications, which will be beneficial for firms to make important strategic and operational decisions in order to achieve economic and environmental competitiveness. Furthermore, from the policy makers' perspective, our research findings provide interesting insights on how different supply chain power relationships affect firms' decision and, as a result, the economic and environmental performances of the entire supply chain. It is valuable for policy makers to create a more sustainable supply chain environment that can promote low carbon economy.

The remaining of this article is organised as follows. After a brief review of research background in Section 2, we present model assumptions and descriptions in Section 3. In Section 4, the manufacturer's optimal wholesale price and unit carbon emissions, and the retailer's optimal retail price are obtained in the manufacturer Stackelberg (MS) model, the vertical Nash (VN) model, and the retailer Stackelberg (RS) model respectively. In Section 5, we focus on how to achieve channel coordination through a two-part tariff contract for the sustainable supply chain. In Section 6, we examine the effect of power relationship on the coordination decisions and sustainability performances of the supply chain. A case study is presented in Section 7, in which numerical examples are provided to give more management insights. Finally, we discuss the managerial implications of our study and possible future work in Section 8.

## 2. Research background

The literature reviewed in this article primarily relates to three research streams: (i) sustainable supply chain management, (ii) coordination in sustainable supply chain management, and (iii) the role of power in sustainable supply chain management.

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