

FROM WASTE TO WORTH: CONTRACT DESIGN FOR GREEN INVESTMENT IN CIRCULAR SUPPLY CHAINS

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Abstract

Green investments in circular supply chains are essential for reducing environmental degradation, conserving resources, and supporting global sustainability objectives. Such investments, such as adopting low-carbon technologies, improving recycling infrastructure, and extending product life cycles, can simultaneously lower ecological footprints and generate financial benefits through cost reductions and efficiency gains. Despite these advantages, firms often hesitate to invest due to high upfront capital requirements, technological uncertainty, and the increased production costs associated with green innovation. These challenges become more complex in multi-firm supply chains where stakeholders may have conflicting objectives. Because green innovation is a key driver of long-term growth, overcoming financial and coordination barriers is crucial. Innovative financing mechanisms and stronger collaboration across the value chain can help firms manage initial investment burdens and accelerate the adoption of sustainable practices. Integrating circularity into supply chain strategies not only enhances environmental and social outcomes but can also improve profitability. Practices such as green design, reverse logistics, and remanufacturing, often capable of reducing production costs significantly, play a central role in enabling circular operations. However, gaps remain in understanding how reverse logistics and closed-loop systems can fully support decarbonization goals, as well as how firms should manage and allocate the costs of green innovation across interconnected supply chain partners. The contribution of the paper lies in providing a game-theoretical model for a two-echelon circular supply chain with an e-retailer and a reseller, with positively correlated demand and green investment. The model consists of a linear demand function, which depends on price and sustainability efforts through a centralized or decentralized decision-making process. The findings

suggest that the chances of achieving optimal levels of sustainability in the supply chain as a whole under the decentralized model often go unfulfilled because of a gap between firms' goals, ultimately impairing the sustainability and profitability of the supply chain as a whole. As a corrective measure for the absence of synchronization between the goals of the firms with those of the supply chain as a whole, two commonly used tools for synchronizing the firms' goals with those of the supply chain as a whole have been identified: The Revenue Sharing contract, as well as the Two Part Tariff contract. Further, results shown by sensitivity analysis indicate that some variables, such as green responsiveness and the intensity of costs associated with sustainable investments, can significantly impact pricing decisions and profit allocation. From a methodological standpoint, the presented research contributes to the existing literature by integrating consumer and sustainability-focused considerations within the economic and strategic framework of circular supply chain configurations. Additionally, it contributes to the contract theory area by demonstrating that the environmental awareness of the demand side can and should be harnessed to align business incentives with environmental responsibility.