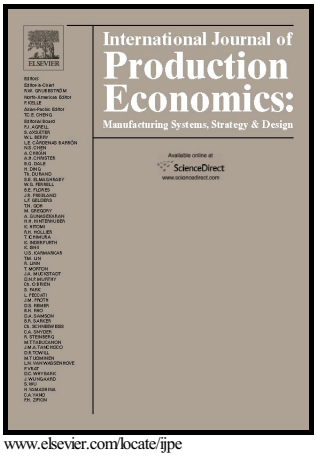

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Supply risk sharing in a closed-loop supply chain

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Abstract

In closed-loop supply chains, the acquisition process of used products or materials often faces high volatility and results in both the uncertain quantity and quality of the recycled products. Such supply uncertainties happen in the reverse supply chain flows while the forward supply chain still faces market demand uncertainty. Managing these uncertainties while coordinating the reverse and forward supply chain flows is one of the many challenges faced by CLSC managers. Among different supply chain management approaches, supply chain contract design has been proven as an effective method for improving supply chain performance. Based on the supply chain contract design theories and focusing on the acquisition process in closed-loop supply chains, this paper analyzes different supply risk sharing contracts including under-supply risk sharing contract, over-supply risk sharing contract, complete supply risk sharing contract, and no risk sharing contract. With game-theoretical models, equilibrium between the recycling price decision (controlling the reverse flow) and the remanufacturing quantity decision (controlling the forward flow) are derived and analyzed. Further, numerical examples are used to demonstrate the managerial results. Based on both the theoretic results and the numerical example illustration, it is shown that different supply risk sharing contracts may result in both the recycling price decision and the remanufacturing production quantity decision to deviate from those decisions under centralized collection structure. Further, this paper investigates the impact of supply or demand risk reduction on the CLSC's financial and environmental performances. It is observed that supply risk reduction approaches may result in the alignment between the CLSC's financial and environmental goals while the demand risk reduction approaches cannot achieve such alignment.

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