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Exploring the Impact of Additive Manufacturing on Supply Chains: A Game-Theoretic Analysis of Manufacturer-Retailer Dynamics

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Abstract : This paper investigates the impact of 3D printing, also known as additive manufacturing, on a multi-item supply chain comprising a manufacturer and retailer. Operating under a wholesale-price contract and catering to stochastic customer demand, this study delves into the largely unexplored realm of how 3D printing technology reshapes supply chain dynamics. A distinguishing aspect of 3D printing is its versatility in producing various product types, yet its slower production pace compared to traditional methods poses a challenge. We analyze the trade-off between 3D printing's limited capacity and its enhancement of production flexibility. By delineating the economic circumstances favoring 3D printing adoption by the manufacturer, we establish the Stackelberg equilibrium in the retailer-manufacturer game. Additionally, we determine optimal order quantities for the retailer considering 3D printing as an option for the manufacturer, ascertain optimal wholesale prices in the presence of 3D printing, and compute optimal profits for both parties involved in the supply chain.

Keywords : additive manufacturing, supply chain management, contract theory, Stackelberg game, optimization
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