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A Pricing Model for a Supply Chain Facing Uncertainty and Autocorrelation

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Abstract

Based on the evidence of autocorrelation in global sales for consumer electronics, this paper addresses the pricing problem between an upstream firm (e.g. Foxconn as a supplier) and a downstream firm (e.g. Apple as a distributer) in a supply chain. In practice, the downstream firm might transfer demand uncertainty to the upstream firm by signing a supply contract with predetermined supply price and quantity. However, when we take into account both uncertainty and autocorrelation effects of demand, the trading price in the supply contract without considering demand's long-range dependence over time is significantly undervalued. Therefore, we adopt a fractional Brownian motion as a key process, which integrates both autocorrelation and stochastic factors in one model. After mathematical derivations, the results demonstrate that the higher the demand autocorrelation, the higher the entry threshold and the later the optimal entry time is. Besides, the real option value is an increasing function of autocorrelation when the Hurst parameter is less than a specific value. Otherwise, it is a decreasing function of autocorrelation. In other words, to reach a fair game in contracting process, the upstream firm should charge more as price premium or charge less as a price discount for the trading price, depending on the degree of autocorrelation of demand in a volatile product market, such as the consumer electronics market.

Keywords: demand uncertainty, autocorrelation, supply chain, entry threshold, real options