

Integrating Inventory Replenishment and Cash Payment Decision in Supply Chains

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Abstract

This paper considers a classic two-stage supply chain, where stage 1 orders from stage 2, which orders from an outside vendor. A new feature of this model is to explicitly consider cash flows: each stage pays its upstream stage for inventory replenishment. To assess the value of payment flexibility, we compare optimal system-wide costs under two payment schemes. For the flexible payment scheme, stage 1 may delay the payment or subsidize cash to stage 2; for the strict payment scheme, stage 1 pays exactly what it orders. We prove that the optimal joint policy for the flexible payment model has a surprisingly simple structure: both stages implement a base-stock policy for inventory replenishment; stage 1 monitors its cash level and implements a two-threshold policy for investment and a pay-up-to policy for inventory payment. Solving the strict payment model is more involved. We derive a lower bound on the optimal cost by connecting the strict payment model to an assembly system and propose a simple heuristic. We also consider a benchmark model, cash pooling, where cash in the supply chain is managed by a single internal bank. The results of numerical studies suggest that (1) the value of flexible payment can be very significant under certain circumstances; (2) the optimal flexible payment policy may retain the majority of the benefit achieved by the benchmark cash-pooling model; (3) the volatility of material and financial flows may not amplify in the same direction under the flexible payment scheme.

Bio

Kevin Shang is an Associate Professor of Operations Management at the Fuqua School of Business, Duke University. He received his M.B.A. from University of California, Riverside in 1998 and Ph.D. from University of California, Irvine in 2002. Prof. Shang's expertise is in supply chain management, production planning and inventory control, and logistics management. His research mainly focuses on developing simple and effective inventory policies for supply chains. He is also interested in interface of operations, finance, and marketing problems. Prof. Shang's research has appeared in *Management Science*, *Manufacturing and Service Operations Management*, *Operations Research*, and *Operations Research Letters*. He currently serves as Associate Editor for *Management Science*, *Manufacturing & Service Operations Management* and *Naval Research Logistics*.