

MAKE-TO-ORDER CONTRACT WITH A BACKUP SUPPLIER UNDER RECURRENT SUPPLY UNCERTAINTIES AND DISRUPTION RISKS

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ABSTRACT. *As more supply chains are becoming dependent upon suppliers, the need and the value of a backup supply is increasingly evident. The purpose of this paper is to help a buyer determine the order quantity of a make-to-order contract with the backup supplier when the main supplier's recurrent uncertainties and possible disruptions are taken into consideration. We show that (1) if no supply disruption is considered, the buyer would rather order less from the backup supplier than that when the risks are decoupled; (2) bundling and decoupling the risks can result in different optimal solutions, and the properties of supply uncertainties and disruption risks play a vital role in the following two ways: (i) with the increase of the recurrent uncertainty, it is better for the buyer to order less from the backup supplier, which is opposite to the decision suggested by the stand-by contract in the literature; (ii) with the increase of the disruption probability, the buyer should order more from the backup supplier. And (3) under the make-to-order contract, bundling the risks can lead to under utilization of the backup supplier when the disruption probability is small enough, but may result in over utilization of the backup supplier when the probability is large.*

Keywords: Make-to-order, Supply uncertainties, Supply disruption, Backup supplier, Decision-making under risk

1. Introduction. With the widespread applications of outsourcing, the manufacturing supply chains are becoming more supplier-dependent. While the suppliers play an important role in achieving the entire supply chain excellence, they also represent one major source of uncertainty and disruption. Many companies have experienced supply disruptions during the series of tragic disasters that have occurred over the past few years. Such disruptions can negatively affect an enterprise's financial performance, such as lowered stock prices and a slower growth rate. A famous example demonstrates the impact of supply disruptions: as a result of the 2000 fire that shut down the Philips Semiconductor plant, Nokia lost all of its supply from the plant, but it was able to temporarily increase production with a backup supplier, while Ericsson has no alternative supplier thus its production was halted for several weeks and lost over \$ 400 million in potential revenue [1]. Therefore, it is usually valuable for buyers to have more than one suppliers or similar products to reduce the supply risks. Using a backup supplier or contracting with a backup supplier is considered a critical issue and an important decision for a buyer. Since most of