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Contents

Disruption Mitigation and Pricing Flexibility

Oben Ceryan and Florian Lücker

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ABSTRACT

We study a firm that is exposed to random supply chain disruptions while producing a single product. During a disruption, the firm may use reserve inventory and/or reserve capacity to serve customer demand. As supply in the form of reserve inventory and reserve capacity is often lower than demand during a disruption, the firm may choose to increase the price of the product during the disruption. An increase in price reduces demand during the disruption, which may help better match supply and demand during the disruption. We find that pricing flexibility (i.e., the ability to increase the price during a disruption) may complement or substitute the operational mitigation levers of holding reserve inventory or reserve capacity. Specifically, when a firm has pricing flexibility, it may be economical to increase or decrease the use of reserve inventory or reserve capacity relative to a setting without pricing flexibility.

This monograph is a short version of the following working paper: Ceryan, O. and Lücker, F. Disruption Mitigation and Pricing Flexibility, working paper, Bayes Business School, City, University of London.

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Optimal Newsvendor IRM with Downside Risk

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ABSTRACT

We analyze the way behavioral preferences featuring downside risk aversion influence the optimal integrated risk management (IRM) of newsvendor revenues. Under the stylized assumption of perfectly correlated demand with financial hedge's underlying, we show two remarkable facts. First, the simultaneous presence of a standard and a downside risk aversion blurs the relevance of an integrated approach to risk management under a conventional expected utility framework. Second, a generalized disappointment aversion utility represents an appropriate decision making setup for devising IRM strategies whose financial hedging component exhibits a relevant effect on the operational handling term.

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Competitive Forward and Spot Trading Under Yield Uncertainty

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ABSTRACT

Agricultural producers face significant yield uncertainty which can cause unpredictable outputs and volatile prices of agricultural commodities. They usually trade those commodities not only in a spot market but also in a forward market to manage price uncertainty. In this section, we develop a game theoretical model to study competing firms' production decisions in the planting season and trading behaviors in the forward and spot markets. The model also allows us to examine the impact of yield uncertainty and the existence of the forward market on the equilibrium outcomes. We find some counterintuitive results that an increase in yield risk may increase firms' equilibrium profits and decrease the spot price volatility. A comparison between the models with and without a forward market reveals that the firms' profits decrease but the spot price volatility increases when there is a forward market. Finally we show that a higher yield risk mitigates the role of the forward market but a higher yield correlation enhances it.

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The Impact of Commodity Price Uncertainty on the Economic Value of Waste-to-Energy Conversion in Agricultural Processing

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ABSTRACT

This section studies the economic implications of waste-to-energy conversion; that is, converting organic waste into a saleable product to be used as a feedstock in another firm (e.g., biomass boiler) to generate energy (e.g., heat, electricity). We focus on the context of an agricultural processor that uses a commodity input to produce both a commodity output and organic waste. By making a comparison with a benchmark case in which waste goes to landfill, we characterize the economic value of waste-to-energy conversion. Using a model calibration based on palm oil industry in Malaysia, we examine how this economic value is impacted by (i) input and output spot price uncertainties and (ii) organic waste price's dependence on the output spot price.

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Corporate Renewable Procurement Analytics

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ABSTRACT

Corporate decarbonization goals have increased rapidly in the last few years. The procurement of renewable power is a core strategy used by companies to meet these goals, increasingly in a dynamic manner that addresses the risks associated with uncertain prices and supply intermittency, among others. This section discusses the interplay between data and decision analytics in this rapidly evolving area by considering the construction of a dynamic portfolio of power purchase agreements, which are popular long-term contracts signed by corporations, to meet a future renewable procurement target. It analyzes a stylized setting to provide insight into the effect on decisions of the joint evolution of uncertainties. It also discusses how forecasts, stochastic processes, and deterministic models can be used to obtain procurement policies in practical settings. These elements have a rich history in operations management but have received limited attention for renewable power procurement. Emphasis is placed on how a traditional rolling planning model based on forecasts can be adapted to this procurement setting, as well as where a recent rolling planning technique based on information relaxations can add value.

Keywords: power purchase agreements; climate targets; renewable procurement; optimization; reinforcement learning; Markov decision processes.

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Blockchain-Based Digital Payment Obligations for Trade Finance

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ABSTRACT

To help deep-tier suppliers access cheaper financing, the downstream anchor manufacturer can issue digital payment obligations (DPOs) based on a blockchain platform. The DPO can be passed on to the upstream of the supply network as a payment instrument and then the deep-tier suppliers are able to adopt factoring at a more favorable financing rate due to the manufacturer's creditworthiness programmed into the DPO. We investigate how DPO adoption impacts the operational decisions and profits of different participants in a three-tier supply network, and examine whether these participants voluntarily accept the DPO. We find that DPO adoption increases the efficiency of the supply network and benefits the downstream manufacturer and the suppliers on the reliable branch. However, the suppliers on the unreliable branch can be worse off. Despite the profit decrease, the suppliers on the unreliable branch accept the DPO voluntarily due to the threat posed by competitors.

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Long-Term Service Agreement in Power Systems

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ABSTRACT

We study a long-term service agreement (LTSA) in a power system between an Original Equipment Manufacturer (OEM) of a conventional power generator and a utility firm. The OEM offers the LTSA to the utility firm which specifies the service fee and the maintenance interval. The utility firm dynamically chooses among different resources (conventional, renewable, or emergency) to meet energy demand. Different from traditional supply chain contracts, an LTSA contracts on a generator's long-term production schedule (i.e., usage time and the number of starts). We characterize that the conventional generator's optimal operating mode (i.e., on or off) follows a two-threshold policy, which shows a hysteresis phenomenon, and capture the OEM's tradeoff between the service margin and the usage of the conventional generator in the LTSA design.

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The Impact of Servicization of Manufacturing Firms on Bullwhip Effects

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ABSTRACT

Service-oriented economies have triggered manufacturing firms to increasingly integrate services into their businesses. This section delves into the impact of servicization on two key bullwhip effects: the felt bullwhip, representing demand variability, and the intra-firm bullwhip, reflecting demand distortion. Manufacturers typically offer services complementing product sales, like maintenance and repair, and those replacing product sales, like machine hours. Employing text mining techniques, two service categories in 10-K reports are identified. Complementing services initially lead to a decrease in demand variability, while substituting services subsequently results in diminished demand distortion.

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