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Research and Management Insights

Dynamic Pricing, Production, and Channel Coordination with Stochastic Learning
Tao Li, Suresh P. Sethi, Xiuli He

Tao Li, Suresh Sethi, and Xiuli He study a decentralized two-period supply chain in which a manufacturer produces a product with benefits of cost learning, and sells it through a retailer facing a price-dependent demand. The manufacturer's second-period production cost declines linearly in the first-period production, but with a random learning rate. The authors show that as the mean learning rate or the learning rate variability increases, the traditional double marginalization problem becomes more severe, leading to greater efficiency loss in the channel. They obtain revenue sharing contracts that can coordinate the dynamic supply chain. In particular, when the manufacturer may hold inventory, they identify two major drivers for inventory carryover: market growth and learning rate variability.

MRP Planned Orders in a Multiple-Supplier Environment with Differing Lead Times
Jan Riezebos, Stuart X. Zhu

Although Material Requirements Planning (MRP) is one of the best known techniques in the field of inventory planning and has been made available in all enterprise resource planning systems, it lacks support for frequently encountered situations where lead times at subsequent ordering moments differ during the planning horizon. These differences might be caused by substitute products offered by multiple suppliers, seasonal transportation effects, or marketing models that allow for higher prices if lead times are shorter. Adequate replenishment methods that can cope with lead time differences are lacking because of the phenomenon known as order crossovers, i.e., replenishment orders arrive in a different sequence than ordered. Riezebos and Zhu generalize theory on MRP ordering by including the occurrence of dynamic lead-time variation and order crossovers. Next, they develop new fundamental insights and an efficient optimal solution procedure, and provide good-performing heuristics for a general and realistic replenishment problem that can be applied in business practice. Furthermore, they conclude that managers should pay serious attention to this impact of lead-time changes and order crossovers on cost performance.

Dynamic Pricing of New Services in Subscription Markets
Nabita Penmetsa, Esther Gal-Or, Jerrold May

Nabita Penmetsa, Esther Gal-Or, and Jerrold May provide important insights to firms that offer new, subscription-based services. In consumer markets, where it is relatively more difficult to implement long term price agreements, the choice of pricing strategy may influence both profits and the rate of adoption of new services. Although access to customer information may help firms to better understand customer behavior and to offer personalized experience, using such information to price discriminate between new and returning customers may not necessarily benefit the firm. In particular, offering introductory discounts to new customers, which may appear to increase customer adoption of new services in the short term, may have a negative impact on firm profits in the long run. Uncertainty regarding the value of new services leads to conflicting inter-temporal incentives for firms and for consumers, complicating firm pricing strategies and adversely affecting profits. It is in the best interest of firms to reduce consumer uncertainty by offering free trial periods or customer discussion forums. Such mechanisms allow consumers to gain experience with the new service prior to making purchasing decisions, and facilitate improved pricing decisions for firms.

Requirement or Promise? An Analysis of the First-Mover Advantage in Quality Contracting
Xinghao Yan, Hui Zhao, Kwei Tang

Yan, Zhao, and Tang analyze the first-mover right in quality contracting by considering two different strategies for the buyer: quality requirement (QR) where buyer moves first by posting quality requirements to the suppliers and quality promise (QP) where buyer voluntarily gives up the first-mover right to the suppliers to request quality promises. They investigate which strategy induces higher quality improvement efforts and the key drivers in the buyer's choice

between the two strategies under supplier competition and/or asymmetric cost information. They also consider the cases when the wholesale price (w) is fixed or negotiable in quality contracting. They find that QR, the premier approach used in quality contracting in practice, limits the suppliers' incentives for quality improvement while QP always motivates supplier(s) to improve quality to the first-best level. However, this does not always guarantee higher expected profit for buyer under QP because both supplier competition and asymmetric information add advantages to QR over QP. Finally, under symmetric information, including w as a contracting decision brings buyer more contracting flexibility under QP but not QR, whereas under information asymmetry, including w gives buyer more power to screen information to reduce the information rent under QR but not QP.

Sourcing with Deferred Payment and Inspection under Supplier Product Adulteration Risk
Huaxia Rui, Guoming Lai

Product adulteration can often arise when a firm outsources its manufacturing functions to suppliers located far away given the difficulty of monitoring the supplier's production process. Previous research has focused on mechanisms such as supplier certification, inspection, and product warranty to mitigate supplier adulteration. However, these mechanisms may not be effective when dealing with far-away suppliers in emerging economies. Recently, researchers proposed the use of deferred payment to deter supplier product adulteration. To enrich the understanding of this mechanism, Huaxia Rui and Guoming Lai study its optimal design with endogenous procurement decision and general defect discovery process. They find that depending on the severity of the moral hazard situation and the adulteration discovery process, either entire or partial deferral can be optimal under the characterized conditions. Because of the supplier's incentive to adulterate, the optimal procurement quantity with deferred payment is generally smaller than the first-best quantity. They also compare this deferred payment mechanism with inspection. Interestingly, they find that the optimal procurement quantity under the inspection mechanism is no less than the first best. Furthermore, the deferred payment mechanism can generally outperform the inspection mechanism when either the buyer's market size is small or his profit margin is low, and it is the converse otherwise. However, if these two mechanisms can be jointly used, they can also be complementary. Rui and Lai find a necessary condition for the optimality of the combined mechanism.

Route vs. Segment: An Experiment on Real-Time Travel Information in Congestible Networks
Vincent Mak, Eyran J. Gisches, Amnon Rapoport

Vincent Mak, Eyran Gisches, and Amnon Rapoport conducted an experimental test of network traffic equilibrium employing a non-trivial network that is complex beyond analysis to ordinary users. Their experimental results provide evidence in support of equilibrium concepts in congestible network analysis. They find no significant differences between two conditions, one where users were provided with en-route travel information and the other where they were not. Their findings are pertinent to the design of systems such as ATIS and ATMS, which are introduced with the aim of reducing road users' uncertainties about route conditions. Their observations suggest that, with or without en-route travel information, traffic might attain similar pattern, if (1) travelers have experience with each other, as in a commuting context, and are informed about ex-post traffic (e.g., in the form of daily traffic information that is commonly available in the media or online); and (2) endogenous strategic interactions, rather than exogenous uncertainties, create the main uncertainties in payoffs. Previous research suggests that travelers have very low willingness to pay for real-time information. This is consistent with their results, which suggest that, at least for commuters who collectively traverse the same congestible network repeatedly, users could establish equilibrium traffic with or without en-route travel information.

Fairness Among Servers When Capacity Decisions Are Endogenous
Xin Geng, Woonghee Tim Huh, and Mahesh Nagarajan

Many service systems are characterized by arriving jobs processed by servers with different service capacities. If the servers are employees, the notion of the workload not being properly distributed can lead to perceptions of unfairness, which have damaging consequences such as employee turnover. Motivated by this phenomenon, Geng, Huh and Nagarajan investigate a system where servers, who derive disutilities from unfairness and being busy, endogenously choose capacities after the routing policy is announced. In particular, they study server's behavior and system performance under four policies. Fast Server First (FSF) policy routes customers to the fastest server; Slow Server First (SSF) to the slowest one. Half-half (HH) policy sends customers to each server with equal probability. Proportional (Prop) has routing probability proportional to the server's expected service time. The findings of the study suggest the following insights: (a) Under Prop and HH policies,

servers' capacity choices will reach a unique equilibrium. (b) The performance of FSF policy is sensitive to how much servers care about fairness, while that of SSF policy is sensitive to the servers' heterogeneity. (c) Prop policy is stable with respect to system parameters and results in a relatively high performance.

An Integrated Text Analytic Framework for Product Defect Discovery
Alan S. Abrahams, Weiguo (Patrick) Fan, G. Alan Wang, Zhongju (John) Zhang, and Jian Jiao

With the increasing popularity of social media, the volume of product-related public postings is growing rapidly. For executives concerned with quality management, identifying postings that are likely to be related to product defects is a daunting challenge. Operations research tools for quality management – such as pareto diagrams and control charts – are applied to structured data, not textual postings. Complaint management and sentiment analysis techniques, for the analysis of unstructured data, presume negative emotion is indicative of defect existence. Recent research, however, shows negative emotion in public postings is poorly correlated with defect existence: customer rants are frequently directed at other users or targets, and often unrelated to product defects. The authors present a comprehensive social media analytic framework which extracts a broad assortment of quantitative measures from online discussion threads. Using case studies from the automotive industry and the consumer electronics industry, the authors demonstrate a method for discerning postings likely to be of greatest concern to quality management executives. Expediting the discovery and remediation of product defects using intelligence gathered from social media can be expected to greatly reduce defect-associated costs, especially for high sales-volume products.

Positioning Inventory in Clinical Trial Supply Chains
Adam Fleischhacker, Anh Ninh, Yao Zhao

Managing inventory within a global supply chain footprint is a difficult task, but it is made even harder when investment in the supply chain may never be fully utilized. Adam Fleischhacker, Anh Ninh, and Yao Zhao consider the case of clinical trial supply chains which support the human testing component of the drug approval process. In these supply chains, the entire supply chain is no longer needed after a certain number of patients are recruited as part of the trial. While a goal of these supply chains is to recruit patients as fast as possible, the reality is that large inventory overages, expensive materials, and costly shipping will lead supply chain managers to seek cost-efficient methods of matching supply and demand. The authors present a class of new supply chain models to generate optimal inventory policies which incorporate the ephemeral nature of clinical trial supply chains through a new constraint, the "end of horizon" constraint. Using these new models in both real-life and simulated examples, the authors demonstrate how both inventory overage and supply chain cost can be significantly reduced as compared to traditional practice. In addition, insights into the drivers of cost and overage are examined. For example, the authors find that limiting the number of countries for global trials is the biggest managerial lever in minimizing both supply chain cost and inventory overage.

Split-Award Procurement Auctions—Can Bayesian Equilibrium Strategies Predict Human Bidding Behavior in Multi-Object Auctions?
Martin Bichler, Kemal Guler, Stefan Mayer

Martin Bichler, Kemal Guler, and Stefan Mayer analyze if and when symmetric Bayes Nash equilibrium predictions can explain human bidding behavior in multi-object auctions. They focus on two sealed-bid split-award auctions with ex-ante split decisions as they can be regularly found in procurement practice. These auction formats are straightforward multi-object extensions of the first-price sealed-bid auction. The authors derive the risk-neutral symmetric Bayes Nash equilibrium strategies and find that, although the two auction mechanisms yield the same expected costs to the buyer, other aspects of the two models, including the equilibrium bidding strategies, differ significantly. The strategic considerations in these auction formats are more involved than in single-lot first-price sealed-bid auctions, and it is questionable whether expected utility maximization can explain human bidding behavior in such multi-object auctions. Therefore, the authors analyzed the predictive accuracy of our equilibrium strategies in the lab. In human subject experiments we found underbidding, which is in line with earlier experiments on single-lot first-price sealed-bid auctions. In order to control for regret we organize experiments against computerized bidders, who play the equilibrium strategy. In computerized experiments where bid functions are only used in a single auction, the authors found significant underbidding on low-cost draws. In experiments where the bid function is reused in 100 auctions, we could also control effectively for risk aversion, and there is no significant difference of the average bidding behavior and the risk-neutral Bayes Nash equilibrium bid function. The results suggest that strategic complexity does not serve as an explanation for underbidding in split-award procurement auctions, but risk aversion does have a significant impact.