

The Hong Kong Polytechnic University
Department of Logistics and Maritime Studies
Research Seminar

Dynamic Pricing and Inventory Management under Network Externalities (with Nan Yang)

by

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Time: 11:00am - 12:00nn

Venue: M104, Li Ka Shing Tower

The Hong Kong Polytechnic University

(Conducted in English)

Abstract:

We study the impact of *network externalities* upon a firm's pricing and inventory policy under demand uncertainty. The firm sells a product associated with an online service or communication network, which is formed by (part of) the customers who have purchased the product. The product exhibits network externalities, i.e., a customer's willingness-to-pay and, thus, the potential demand are increasing in the size of the associated network. We show that a network-size-dependent base-stock/list-price policy is optimal. Moreover, the inventory dynamics of the firm do not influence the optimal policy as long as the initial inventory is below the initial base-stock level. Hence, we can reduce the dynamic program to characterize the optimal policy to one with a single-dimensional state-space (the network size). Network

externalities give rise to the tradeoff between generating current profits and inducing future demands, thus having several important implications upon the firm's operations decisions. Compared with the benchmark case without network externalities, the firm under network externalities sets a higher base-stock level, and charges a lower [higher] sales price when the network size is small [large]. When the market is stationary, the firm adopts the introductory price strategy, i.e., it charges a lower price at the beginning of the sales season to induce higher future demands. The price discrimination and network expanding promotion strategies can effectively leverage network externalities and improve the firm's profit. Both strategies facilitate the firm to (partially) separate generating current profits and inducing future demands through network externalities. Our extensive numerical studies demonstrate the significant profit loss of ignoring network externalities. We also propose near-optimal heuristic policies that leverage network externalities by balancing generating current profits and inducing demands in the *near future*.

Bio:

Renyu (Philip) Zhang is a fifth-year PhD candidate in Operations Management from Olin Business School, Washington University in St. Louis. His research interests focus on addressing fundamental operations issues under the emerging trends in technology, marketplace, and society. Philip's PhD thesis, "Dynamic Pricing and Inventory Management: Theory and Applications" (supervised by Prof. Nan Yang and Prof. Fuqiang Zhang), seeks to understand how a firm should dynamically optimize and coordinate the price and inventory decisions under an uncertain (and possibly competitive) market environment. He has developed the models and methods to analyze the pricing and inventory policy under some emerging market trends such as social networks, sustainability concerns, and commodity price fluctuations. His research works have been published in top-tier operations management journals such as *Operations Research* and *Manufacturing and Service Operations Management*. In the future, Philip wishes to devote his intellectual efforts to two streams of research: (a) operations management under social interactions (e.g., social networks) and (b) sustainable operations.

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All are welcome!