Chapter 75
Advertising and Pricing Decisions in a Manufacturer–Retailer Channel with Demand and Cost Disruptions

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ABSTRACT

This paper investigates advertising level, pricing and production quantity decision problems in a supply chain when demand and production cost disruptions occur simultaneously. The supply chain consists of one manufacturer and one retailer where customer demand depends on the retail price and advertisement expenditure. The authors examine this problem in two game-theoretic models: a cooperative game and a non-cooperative Stackelberg-manufacturer game, respectively. Propositions and insights are developed from the analysis of these models. The original production plan has some robustness in face of the disruptions of demand and production cost in both cooperative and non-cooperative models. Only when the disruptions exceed some thresholds will the channel members take an overall adjustment. In addition, the cooperative channel achieves higher channel profits and higher social surplus than the non-cooperative model by using a lower retail price and a higher level of advertising efforts to promote demand.

1. INTRODUCTION

With the deepening of economic integration and globalization, firms are more sensitive to the unexpected changes from the external environment to internal operational efficiency. Supply chain disruption management, focused on maximizing total profits of the supply chain and individual profits of channel members after uncertain risk factors occur, gains more attention than ever. Disruptive events significantly affect the performance of the supply chain. To attain high level performance, managers should ensure the supply chain is robust sufficient to deal with the uncertainties and adjust the production plan in response to disruptions. In this paper, we investigate how to revise the original production plan in a one-supplier-one -retailer supply chain where demand is influenced by both price and advertising level under both demand and production cost disruptions.

As advertising is one of the most utilized tools to build brand image and strengthen customer loyalty, almost every famous enterprise invests huge amounts in advertising to stimulate consumer purchase, for example, P&G in 2013 invested about 1.5 billion RMB into online advertising and about 600 million RMB into offline advertising in China. In fact, besides price, advertisement also indeed influences the customers' preferences and their purchasing decisions, and then expands the market demand. Compared advertised with unadvertised brands, empirical evidence on price sensitivity indicates that the use of advertising leads to lower price sensitivity among consumers (Kaul & Wittink, 1995). Furthermore, the targeting of advertising is valuable for firms in a competitive environment which leads to higher profits in the supply chain (Iyer, Soberman, & Villas-Boas, 2005). Hence, advertising is a strategic and tactical decision managers must take into account.

The impact of retail price and advertising expenditure on demand has been the focus of many research studies. Based on the wholesale price only contract frame work, Chu (1992) examined signaling of high demand by increasing the wholesale price and advertising. Bagwell and Ramey (1994) reported that higher advertising expenditures result in higher prices and higher social surplus by directing customers to the advertised products, while Soberman (2004) found the relationship of advertising and pricing can be different according to the level of differentiation between competing firms. In addition, Karry and Zaccour (2006) proved that cooperative advertising is an efficient counterstrategy when the national brand and private label are competing strongly. In static models, based on different demand-price functions, Huang and Li (2001) explored the role of co-op advertising efficiency in Nash, Stackelberg and cooperative game, while SeyedEsfahani, Biazaran and Gharakhani (2011) and Xie and Neyret (2009) analyzed Nash, Stackelberg-manufacturer, Stackelberg-retailer, and cooperative game. Meanwhile, some literatures focused on dynamic, intra-channel relationships between channel members, including De Giovanni and Roselli (2012), He, Prasad and Sethi (2011, 2012), Zhang and Xie (2012). However, all the literature above assumed that demand and cost were given and known.

Traditionally, the supply chain is assumed to run smoothly under a deterministic environment. However, after the plan has been settled down, the environment still faces unexpected risks. Economic policies adjustment, natural disasters and transportation delays may lead to changes in the demand or fluctuations in the production cost. On the one hand, the market scale is usually disrupted by some unexpected external events, such as, the outbreak of SARS caused a large sudden increasing demand for respirators; the epidemic of mad cow disease affected a large degree of the demand for beef consumption. On the other hand, the production cost disruption is typical in the changes of the internal operational environment, such as the raw material shortage, the machine breakdown, the new tariff policy, and so on. In 2002, the US government raised imported steel tariffs by up to 30%, causing a big raw material

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