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Review Coordination of Advertising Policy and Its Effect on Competition Between Retailer and Manufacture in the Supply Chain

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Keywords

Cooperative promotion efforts,
Supply chain,
Nash game,
Local advertising,
National advertising.

Abstract

The present paper aims to review the effect of cooperative promotion efforts in a two-stage supply chain and its effect on the competition between retailer and manufacturer in it. Here, the supply chain has a monopolistic manufacture and duopolistic retailers. In this chain, retailers compete with each other to invest in local advertising on the market by assuming that the investment made in local advertising is paid to the retailers by the manufacture. In addition, non-cooperative game scenarios were used based on the two principles of collusion and Cournot for retailers, according to which two Nash-Cournot and Nash-Collusion models were created. For each of the presented models, the optimal solutions of the variables and the unique equilibrium point were determined. In addition, a comparison between promotion efforts of all members of the supply chain along with the participation rate of the manufactures in advertising programs under the parameters of K and θ was investigated. The results obtained from the proposed approach indicated that the rate of participation in promotion efforts is equal for both models, K as the amount of local retailer's ads in collusion mode equals to Cournot mode, the national cost of advertising produced by the producer is equal for both models, and finally the optimal profit of the retailer is more in collateral mode than that of the Cournot state.

1. Introduction

Supply chain management (SCM) has various applications in different businesses such as logistics, shopping, advertising, inventory control and pricing [1-2]. Conceptually, SCM is divided into two parts. The first component of SCM consists of business integration, and the latter includes implementation measures to manage the entire distribution channel from the manufacturer to the ultimate user [3-5]. Based on the concept of functional integration, SCM extends the chain beyond a company to all companies involved in the chain. In this way, each member of the Supply Chain (SC) helps another to improve competitiveness in the SC [3]. Ellram and Cooper proposed three main goals for implementing SCM such as reducing inventory investment in the chain increasing customer service, increasing the availability of inventory, and reducing the time of order cycle and contributing to the competitive advantage of the channel in order to create the value for the customer. Nowadays, increasing competitive edge in business is related to developing technology, changing the customers' demands, globalization, and decreasing the product lifecycle. The SC plays a significant role in obtaining a larger market share in these circumstances [6]. The concept of SCM is derived from the literature of logistics which play a significant effect on its concept. The main logistics effect of the SCM concept is related to the objectives of implementing SCM implementation including the reduction of inventory and increasing the available inventory [7].

In the literature, SC coordination can have a better performance on distribution channels SC if it is conducted through cooperative promotion and pricing policies [1, 8]. In addition, cooperative promotions and pricing policies in marketing plans play a significant role in SC coordination [9]. In fact, advertising programs are regarded as one of the key tools for boosting brand names in industries. According to Huang et al. [10], there are two types of promotions available to the manufacturer and retailer: (1) national promotion and (2) local advertising. National promotion efforts are usually conducted by upstream members of the chain such as manufacturers. This type of advertising aims to increase the information of the brand and the popularity of the product in the customers' minds [6]. In addition, the goal of downstream chain supply like retailers to local advertising

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is improving potential consumers to increase sales. The cooperative advertising is a potential strategy in which the manufacturer intends to measure the effect of retail operations through the payment of advertising costs invested by the retailer [11]. The cooperation between manufacturer and retailer to repay a percentage of the cost of local advertising, the retailer will be more motivated to participate in local advertising [1]. Cooperative advertising can considerably increase market demand, which increases profitability in the SC [12]. In a SC, advertiser variables are created by individual members' effects on the performance of other members of the SC. Therefore, advertising policies in the SC are often considered analytically through the game theory approach. Generally, competition among the different levels of the SC is achieved through three games including the Stackelberg manufacturer, the retailer Stackelberg and the Nash equilibrium. In addition, through Cournot and Collusion games, one can predict the behavior of the downstream members of the SC. According to the Cournot game, which is a well-known competing platform, members of the SC decide to work independently. Based on the collusion approach, the competitor members cooperate with each other to change the product in favor of local action [6].

Game theory approaches are used to evaluate the performance of cooperative advertising in the coordination of the SC. The acquisition of co-channel under cooperative promotion games is a significant issue which relies on improving the SC performance.

2. Literature Review

In recent years, much attention has been paid to the coordination of the SC under various structures. A number of studies have focused on the coordination of SC channels regardless of the principle of competitiveness. On the other hand, some studies have been conducted on SC coordination by considering competitive advantage. Cooperative advertising is an interesting topic for many Researcher having a significant share in the automotive industry [6, 13-16]. Therefore, the present study focuses on examines the promotion models [17]. In the literature on cooperative advertising, the existing models are divided into static and dynamic categories. Static models study cooperative advertising over a period of time. However, dynamic models examine the consumer goodwill through local and national advertising over a long period of time [1].

The first static cooperative advertising model was presented by Berger. In this study, a mathematical model was used to study the effect of consumer goodwill advertising on a manufacturer-retailer SC [18]. Dant and Burger developed the previous Burger model to obtain manufacturer and retailer advertising costs by using game theory [18]. They believed that game theory is a well-known approach for examining the role of cooperative promotion effort models in the SC of the manufacturer/retailer [19]. Huang and Li, Huang et al. and Li et al. developed the previous models of Burger [18-19] in the SC based on various advertising decisions between the manufacturer and the retailer. Huang and Lee, considered the efficiency of cooperative advertising in terms of the volume of the exchange in the SC using game theory and the application of the chain model to determine the advertising costs [20]. Huang et al. and Lee et al. considered similar approaches in order to investigate the effect of investment on brand names in the SC of the manufacturer-retailer [21]. They indicated how members of a chain are able to divide their profits by using Elashberg bargaining model.Yu et al., based on Huang and Lee's actions related to cooperative advertising efforts, examined the SC of the manufacturer -retailer when the producer offers a price discount [22]. Xie and Neyret examined the Huang and Lee models for optimal price and collaborative advertising strategies in the chain between manufacturer and retailer [12]. Yang et al. reviewed cooperative promotion efforts in the SC for establishing equality or justice [23]. The dynamic models of collaborative advertising strategies are based on reference models [24, 25]. Chitagunta and Jain studied the dynamic effect of chain members on advertising [24]. Jorgenson et al. examined the effect of cooperative promotional strategies in a SC with a producer and a retailer to increase customer goodwill and sales in the long and short run [26]. Karay and Zaccour developed the model suggested by Jorgenson et al. to reduce the negative effects of private labels by using cooperative promotion efforts [22]. Li et al., evaluated the issue of cooperative advertising in monopolistic and duopolistic (competitive) models by using static and dynamic game theory [22]. The analysis indicated that competitive behavior affects the profit of all members involved in the chain [27]. The effect of local advertising investments on customer demand has been evaluated by many scholars in cooperative and non-cooperative situation. Tiajun et al. reviewed a SC with a producer and a monopolistic retailer. In this chain, the retailer sells a seasonal product on the market. The retailer should consider the cost of local advertising based on the results of customer demand. The proposed model is implemented based on retail decisions and cooperative scenarios [28]. In addition, Mirzaee et al. considered the SC in which the producer sells a product through two retailers. In this model, the sales volume is considered to be influenced by the level of retailer promotions. The Stackelberg manufacturer's game has been reviewed in this model with cooperative scenarios. The Stackelberg producer's game was studied in their model along with cooperative scenarios. They achieved cooperative channels through sharing discounts and advertising costs [29]. Tsao and Sheen formulated a two-channel SC, which includes a manufacturer and two retailers. In their model, two retailers compete in competitive promotion. Their model is based on the decision of retailers and cooperative scenarios. In order to obtain coordination in the SC, the cost of supplying information in the SC was applied in the model [30]. Subsequently, Giri and Sharma considered a two channel SC with a manufacturer and two retailers, with two retailers competing in local advertising. Their SC model was studied with the help of the Stackelberg producer, where the producer is the leading (leader) and wholesale distributor of the price determines the price for the retail sale [9].

In Table 1. Shows the models of the reviewed papers are classified in Variables, Advertising Demand, Demand function type, Channel Structure and Game strucrure.

3. Symbolization

Table 2 indicate the symbols used for variables and parameters in the developed models**.**

Table 1. The structure of the cooperative advertising models

Reference	Variables	Advertising Demand	Demand Function	Channel Structure	Game Structure
[27]	• Order amount • Retail Price • Producer Promotional • Programs wholesaler Price	$D-\beta(1+m)^{-\mu}(1+v)^{-V}$	Stochastic	A manufacture-A retailer	Stackelberg and Producer of Coordinate Game
[11]	• Local Advertising • Wholesale Price	$\alpha+\beta\sqrt{I_i}-\gamma\sqrt{I_j}$	Deterministic	A manufacture-Two retailers	Nash and Stackelberg Producer
[23]	• Order amount • Local advertising • Wholesaler Price	$a_i+b_ie_i-k_ie_j+\varepsilon_i$	Stochastic	A manufacture-Two retailers	Stockelberg Producer and Coordinate game
[26]	• Order amount Wholesaler Price • Advertising Subsidy rate	$kI^{\beta}+\varepsilon$	Stochastic	A manufacture-A retailer	Retailer Decision and Coordinate game

Table 2. Symbols

Description	Decision variable
The rate of local retailer promotions	a_i
The rate of National Producer Advertising	A
The ratio of capital paid for local advertising by the manufacturer to the retailer (participation rate)	$\emptyset$
Description	**Parameter**
Rate of retailer demands	$D(a_i,A)$
First demands of retailer rate i	α_i
Rate of retailer demand i since his advertising	λ
Rate of retailer demand i since competitive advertising	γ
Rate of demands by national advertising	δ
The final profit of retailer	m_0
The final profit of producer	m_1
Price development	v
Producer marginal profit	θ

4. Decision Model Development

The function of retailer and manufacture profit is shown in the Eqs. (1) and (2) are used to SC solving problem. The retailer's profit function is defined based on the sale revenue and advertising expenditures.

$$TP_i(a_i)=m_0\left(\alpha_i+\lambda a_i-\gamma a_j+\delta A\right)-(1-\emptyset)(\tfrac{1}{2}a_i^2) \quad (1)$$

where the manufacture's profit function includes sale revenue, the cost to local advertising and the rate of participation in the local promotions for retailers.

$$TP_m(A,\emptyset)=m_1[(\alpha_1+\alpha_2)+\alpha_1(\lambda-\gamma)+a_2(\lambda-\gamma)+2\delta A]-\tfrac{1}{2}A^2-\emptyset(\tfrac{1}{2}a_1^2+\tfrac{1}{2}a_2^2) \quad (2)$$

In order to make a good decision, two non-cooperative models have been explored among channel members such as Nash-Cournot and Nash-Collusion as described in sub-sections 4.1 and 4.2.

4.1. Nash-Cournot

In this model, the retailer's behavior is consistent with the Cournot. In other words, retailers are interested in strengthening their competitive behavior and The Nash game is considered between the members of the SC. In this case, the cost spent on advertising and the participation rate by the members of the SC will be made under the non-cooperative game. The optimal amount of Cournot game variables for Nash and are calculated based on the results of Proposition 1. shown below for the Nash-Cournot model (NCt).

Proposition 1: Solutions of Nash-Cournot model (NCt)

Condition 1: If θ is strictly smaller than $\frac{\gamma^{\lambda}}{2\delta^2}-\frac{\alpha_i}{2\delta^2 m_0}-\frac{\lambda^2}{4\delta^2}$ there is no equilibrium.

Condition 2: if θ is strictly greater than $\frac{\gamma^{\lambda}}{2\delta^2}-\frac{\alpha_i}{2\delta^2 m_0}-\frac{\lambda^2}{4\delta^2}$ there is a unique equilibrium. Then, we have the following equation:

$$A^{Nct}=2\theta m_0\delta \quad (3)$$

$$\emptyset^{NCt}=0 \quad (4)$$

$$a_i^{NCt} = m_0\lambda \quad (5)$$

4.2. Nash-Collusion Model

In this model, the retailer adopts collusion behavior. In addition, the game is played in the levels of the SC. According to the collusive behavior, retailers tend to work together to maximize their profits. Based on the Nash and according to the collusion behavior of the retailer, the optimal values for the Nash and collusion games are calculated based on the results of proposition 2 shown below for the NCN model.

In addition, based on the collusion behavior between retailers, the profit function is obtained according to Eq. (6).

However, according to this scenario, the producer's profit function is similar to Eq. (2)

$$TP_R(a_1, a_2) = TP_1(a_1) + TP_2(a_2) = m_0[(\alpha_1 + \alpha_2) + \alpha_1(\lambda - \gamma) + a_2(\lambda - \gamma) + 2\delta A] - \frac{(1-\emptyset)}{2}(a_1^2 + a_2^2) \quad (6)$$

Proposition 2: Nash-Collusion model solutions

$$A^{NCn} = 2\theta m_0\delta \quad (7)$$

$$\emptyset^{NCn} = 0 \quad (8)$$

$$a_i^{NCn} = m_0(\lambda - \gamma) \quad (9)$$

There is Proof and Verify the theorem section 4, 4.1 and 4.2 in Johari et al.,[6].

5. Decision

In this section, the comparison between the optimal solutions available between the two models is analyzed for participation rate, local retailer promotions, national producer cost, and the total profit of the producer and retailer. The comparison is made based on two parameters θ and K. The parameter K represents the effect of competition between retailers in local advertising programs defined in Eq. (10)

$$K = \lambda - \gamma \quad (10)$$

As indicated in Table 3, the producer participation rate in the promotion programs of retail sales is zero for both the NCt and NCn models. The amount of local retailers' sales is more when they compete with each other than when they are colliding with each other..In fact, this value in the NCn, K model is equal to the NCn model. The cost of national advertising for the consumer is equal to each other. In other words, $A_{NCt} = A_{NCn}$. In addition, optimizing the profitability of the retailer and the manufacturer, according to the NCn model, the retailer obtains more profits than the amount in the NCt model. Compared to the NCn model, NCt's model is higher than the manufacturer's profit.

Table 3. Optimal results of variables from NCt and NCn Models

Decision variable	NCt	NCn
a_i	$m_0\lambda$	$m_0(\lambda - \gamma)$
A	$2\theta m_0\delta$	$2\theta m_0\delta$
$\emptyset$	0	0

Table 4. SC member profit from NCt and NCn models

Profit	NCt	NCn
Manufacture	$\theta m_0[(\alpha_1 + \alpha_2) + 2m_0(\lambda(\lambda - \gamma)) + \delta^2\theta]$	$\theta m_0[(\alpha_1 + \alpha_2) + 2m_0\theta^2[(\lambda - \gamma)^2 + \delta^2\theta]$
Retailer	$m_0\alpha_i + \frac{(m_0\lambda)^2}{2} - m_0^2\gamma^\lambda + 2\theta m_0^2\delta^2$	$m_0\alpha_i + \frac{m_0^2(\lambda - \gamma)^2}{2} + 2\theta m_0^2\delta^2$

6. Conclusion

The present study aimed to evaluate the effects of local advertising programs of retailers and national advertising shares of manufactures in the SC. In the SC, the manufacturer sells a monopolistic product between retailers who behave in a bipolistic fashion and faces various demands from customers. In the considered structure, retailers in the market compete for their local advertising programs. For this purpose, the SC structure was investigated on two models: (1) the Nash-Cournot model and (2) the Nash-Collaboration model. Then, the optimal solution of the variables and the unique equilibrium point was determined in each model presented,. In addition, the comparison among the advertising programs of all members of the SC, along with the participation rate of manufacture in these programs was examined under the parameters of K and θ. In Nash's proposed approach, the game was implemented based on two principles of competitiveness and collusion between retailers. Based on these two principles, retailers prefer to cooperate in advertising according to the principle of collusion. In contrast, the manufacturer wants to be consistent with the principle of crankcase with the retailer. The cost of local advertising spent by retailers in collusion mode is lower than that of the Cournot game. Further, according to the Nash game, the manufacture is more interested in investing in advertising programs. The present study can be expanded by considering the effect of retail price as a competitive factor. In addition, the customer demand function can be considered as the probable variable.

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