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Analysis of Advertising Marketing and Welfare in a Supply Chain

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Abstract

Quantity competition in advertising is a game with a second-mover advantage. Firms engaging in advertising efforts will increase market segmentation for their products but gain less profit. Through advertising, whether or not firms engage in advertising expenditures, all firms across the supply chain benefit from advertising activities, thereby enhancing social welfare. However, consumer surplus invariably decreases, harming consumer interests.

Keywords

Advertising Marketing, Cournot Competition, Supply Chain

1. Introduction

In a supply chain, it is widely recognized by consumers that identical products can have different pricing and services. For example, parallel imports in overseas markets compared to locally authorized Apple phones, variations in booking systems among different agents in the airline and hotel industries, and differences in e-commerce platforms all highlight that even when purchasing the exact same product, the disparities in distribution channels and services can be substantial. Examining whether advertising or marketing efforts that create channel differentiation affect consumer rights and social welfare is a critical issue in many countries. This is particularly important when considering the formulation and enforcement of antitrust laws or fair-trade laws, which have significant implications for market order.

Advertising is regarded as a competitive tool. Its role is to increase consumer awareness and choices. Traditionally, economists have identified two perspectives

on advertising. One view is that advertising is inefficient; it only increases market segmentation and brand loyalty without contributing to overall market benefits, and the associated expenses significantly raise firms' operational costs. The other view posits that advertising can timely educate consumers about new consumption habits or patterns, especially during the launch of new products, guiding consumers towards more informed choices, thereby enhancing overall social welfare. Depending on the nature of the product, advertising is classified into informative advertising and persuasive advertising (Prabhu & Tellis, 2000). Informative advertising is typical for everyday products, where consumers are already aware of their functions and effects before purchase. The role of advertising here is to provide consumers with an alternative to their habitual choices. Persuasive advertising, on the other hand, is commonly used for experience goods and credence goods. Experience goods, such as travel services, fitness programs, and movies, require consumer purchase and experience to ascertain their effectiveness. Credence goods, like legal consulting and medical services, involve consumers who, due to a lack of expertise, cannot determine the efficacy before or after purchase and must rely on trust.

If advertising can expand market share and achieve economies of scale, it inevitably becomes one of the competitive tools. The Dorfman-Steiner condition (Dorfman & Steiner, 1954) illustrates that a monopolistic firm, under profit-maximizing conditions, will allocate a certain proportion of its revenue to advertising expenditure. When market demand elasticity is lower or advertising elasticity is higher, the monopolistic firm's advertising investment increases. Advertising behavior thus becomes an internalized component of market competition. This motivates the current study to understand the changes and impacts on firms' profits and social welfare when advertising intervenes in market segmentation behavior.

In a vertical wholesale-retail structure, Choi (1991) summarizes the channel power structure into three categories: 1) Manufacturer Stackelberg: The manufacturer is the leader of the channel, possessing greater channel power. In this case, the manufacturer first determines the wholesale price of the product, and the retailer then sets the retail price to maximize its profit. 2) Vertical Nash: The manufacturer and the retailer have equal channel power. The wholesale and retail prices of the product are jointly determined by the manufacturer and the retailer. 3) Retail Stackelberg: The retailer is the leader of the channel, possessing greater channel power. Here, the retailer first determines the retail margin, and the manufacturer subsequently sets the wholesale price to maximize its profit.

Choi (1996) considers a theoretical model involving two manufacturers and two retailers under three types of channel power structures: manufacturer leadership, vertical Nash, and retailer leadership. The model uses a linear demand function that includes product differentiation and retail store differentiation. The research findings indicate that for all three types of channel power structures, greater product differentiation leads to increased manufacturer profits and decreased retailer profits; greater retail store differentiation leads to increased re-

tailer profits and decreased manufacturer profits. Both greater product differentiation and greater retail store differentiation result in higher equilibrium retail prices, which yields conclusions different from those of Choi (1991).

Tyagi (2005) posits that within channel structures, wholesale and retail prices can be designed in various forms. For instance, Choi (1991, 1996) designed models where the manufacturer determines the wholesale price, and the retailer sets the retail margin price markup, with the sum of the wholesale price and retail margin constituting the retail price of the product. Shugan (1985), Jeuland and Shugan (1988), and Lee and Staelin (1997) designed models where the manufacturer determines the wholesale margin as an added cost, and the retailer determines the retail margin. On the other hand, McGuire and Staelin (1983), Gerstner and Hess (1991), Raju, Sethuraman and Dhar (1995), and Tyagi (1999) designed models where manufacturers and retailers separately determine the wholesale price and retail price. Liu, Cai and Tsai (2014) advocated advertising in asymmetric competing supply chains and examined the efficacy of cost sharing in a model of two competing manufacturer-retailer supply chains who sell partially substitutable products that may differ in market size.

This paper considers the establishment of a production design within an upstream and downstream supply chain industry. The upstream consists of a monopolistic manufacturing wholesaler, while the downstream includes one advertising retailer and one non-advertising retailer. Using a two-stage game analysis framework, the paper explores the implications of advertising on vertical market welfare. Specifically, it aims to investigate how advertising behavior affects firm profits, consumer surplus, and social welfare. Additionally, it examines whether advertising can enhance firm profits or social welfare.

To achieve these objectives, we adopt the model assumptions similar to those in Choi (1991) to explore the decision-making of the involved agents. Methodologically, the study employs a game-theoretic model framework to analyze market behavior in the upstream and downstream segments of the supply chain and to infer the basis for relevant government regulations. The sequence of the game is as follows: in the first stage, the monopolistic manufacturing wholesaler determines the profit-maximizing wholesale price. In the second stage, the two retailers engage in heterogeneous quantity (Cournot) competition induced by advertising behavior. Using backward induction, the paper solves for the sub-game perfect Nash equilibrium (SPNE) to identify the optimal decision quantities and proposes recommendations for related market behaviors accordingly.

2. Basic Model

Assume there are three types of firms in the market: one monopolistic upstream common manufacturing wholesaler (M) that determines the common wholesale price w, and two downstream retailers engaging in quantity (Cournot) competition. Among them, one retailer engages in marketing and advertising efforts, making it a differentiated retailer from the other. The supply quantities in the

market are q_0 and q_1 respectively, with the total market supply being $Q=(q_0+q_1)$. The consumer utility function of the typical consumer is

$$U=a(q_0+q_1)-\frac{1}{2}\left(q_0^2-2bq_0q_1+q_1^2\right)+I \tag{1}$$

where a represents the product market size, I denotes other neutral goods utilities, b is the retail heterogeneity parameter with $0<b<1$. When b approaches 0, it indicates greater differentiation between retailers, reflecting stronger advertising and marketing efforts by the advertising retailer. Conversely, when b approaches 1, it indicates smaller differences between retailers, showing that consumers perceive little difference in the products and services offered by the retailers.

The inverse market demand for the retail firms can be derived as follows:

$$\begin{aligned} p_0 &= a-q_0-bq_1 \\ p_1 &= a-q_1-bq_0 \end{aligned} \tag{2}$$

The profit functions for the manufacturing wholesaler and the retail firms respectively are:

$$\pi_0=(p_0-w)q_0-c^2m-f$$

$$\pi_1=(p_1-w)q_1-f$$

$$\pi_M=w*Q-\frac{Q^2}{2}$$

where m represents the amount of advertising and f represents the setup cost for the retail firms. As the advertising retailer needs to make more marketing efforts to differentiate its marketing channels, its advertising and marketing costs will be higher than those of the other retail firm. Therefore, the advertising unit cost for the advertising retailer is denoted as c^2, with advertising expenditure equal to c^2m, which does not vary with the output amount. For analytical convenience, it is assumed that $*m=k^2$, where $m>1$ and k is a constant term to ensure that $0<b<1$. The production cost for the monopolistic wholesale manufacturer is designed as a quadratic function $C(Q)=Q^2/2$. Finally, the consumer surplus (welfare) function is

$$CS=U-p_0q_0-p_1q_1 \tag{3}$$

2.1. Production, Pricing, and Consumer Welfare without Advertising Efforts (Benchmark: $b=1$)

First, using backward induction, considering retail competition at the retail stage, the profit-maximizing first-order condition for the retail firms under homogeneous symmetric design, we obtain:

$$q_i=\frac{a-w-q_{-i}}{2},\quad i=0,1 \tag{4}$$

By simultaneously solving (4), the total market supply can be obtained.

$$Q = \frac{2(a-w)}{3}$$

Returning to the first stage of the game, we seek to find the wholesale pricing set by the manufacturing wholesaler under profit maximization. The first and second-order conditions are as follows:

$$\frac{\partial \pi_M}{\partial w} = \frac{2}{9}(5a - 8w) = 0$$

$$\frac{\partial^2 \pi_M}{\partial w^2} = -\frac{16}{9} < 0$$

Through the first-order condition, the optimal common wholesale price can be obtained.

$$w = \frac{5a}{8} \tag{5}$$

Through the result of Equation (5), the sub-game perfect Nash equilibrium (SPNE) can be obtained, as described in Lemma 1.

Lemma 1: *Production, pricing, and welfare of retail firms without advertising efforts are listed as follows*:

$$q_0 = \frac{a}{8},\ q_1 = \frac{a}{8},\ Q = \frac{a}{4},\ p_0 = \frac{3a}{4},\ p_1 = \frac{3a}{4},\ \pi_0 = \frac{a^2}{64} - f,$$

$$\pi_1 = \frac{a^2}{64} - f,\ \pi_M = \frac{a^2}{8},\ CS = \frac{a^2}{32},\ SW = \frac{3a^2}{16} - 2f + I.$$

2.2. Production, Pricing, Advertising Levels, and Consumer Welfare

Through the aforementioned analysis, in this section, additional advertising expenditures and the competition among retail firms, the first-order conditions for maximizing the profit of retail firms with respect to output and advertising level can be obtained.

$$\frac{\partial \pi_0}{\partial q_0} = a - w - 2q_0 - \frac{k^2 q_1}{m} = 0$$

$$\frac{\partial \pi_0}{\partial m} = \frac{k^2 q_0 q_1}{m^2} - c^2 = 0$$

$$\frac{\partial \pi_1}{\partial q_1} = a - w - \frac{k^2 q_0}{m} - 2q_1 = 0$$

Solving the above three equations simultaneously, the optimal output and advertising level under profit maximization can be obtained.

$$q_0 = \frac{1}{2}(a - w - ck)$$

$$q_1 = \frac{1}{2}(a - w - ck)$$

$$m = \frac{k(a - w - ck)}{2c} \tag{6}$$

That is, the output of the advertising firm is the same as that of the non-advertising firm, and advertising behavior leads to the free rider problem in the retail channel. Utilizing the result from (6), the total market supply can be derived.

$$Q=(a-w-ck)$$

Returning to the first stage of the game, we find the wholesale price that maximizes the profit for the manufacturer and wholesaler. The first-order and second-order conditions are as follows:

$$\frac{\partial \pi_M}{\partial w}=2a-3w-2ck=0$$

$$\frac{\partial^2 \pi_M}{\partial w^2}=-3<0$$

Through the first-order condition, the optimal common wholesale price can be obtained.

$$w=\frac{2}{3}(a-ck) \tag{7}$$

We obtain the Subgame Perfect Nash Equilibrium (SPNE), as described in Lemma 2.

Lemma 2: *The production, pricing, advertising expenditures, and welfare under advertising efforts are listed as follows*:

$$q_0=\frac{1}{6}(a-ck),\ q_1=\frac{1}{6}(a-ck),\ Q=\frac{1}{3}(a-ck),\ p_0=\frac{5}{6}(a-ck),$$

$$p_1=\frac{5}{6}(a-ck),\ m=\frac{q_0}{c}=\frac{k(a-ck)}{6c},\ c^2m=\frac{ck(a-ck)}{6},$$

$$\pi_0=\frac{1}{36}(a-ck)(a-7ck)-f,\ \pi_1=\frac{1}{36}(a-ck)^2-f,\ \pi_M=\frac{1}{6}(a-ck)^2,$$

$$CS=\frac{1}{36}(a-ck)(a+5ck),\ SW=\frac{1}{4}(a-ck)^2-2f+I.$$

3. Comparison of Firm Profits and Consumer Welfare

Based on the analysis done in the second section, the profit and consumer surplus of the retail firm under the condition of no advertising effort in market segmentation is denoted as *N*, respectively.

$$\pi_0^N=\frac{a^2}{64}-f$$

$$\pi_1^N=\frac{a^2}{64}-f$$

$$\pi_M^N=\frac{a^2}{8} \tag{8}$$

$$CS^N=\frac{a^2}{32}$$

Under the advertising efforts, the profits and consumer surplus are denoted by

A, respectively, as follows:

$$\pi_0^A = \frac{1}{36}(a-ck)(a-7ck) - f$$

$$\pi_1^A = \frac{1}{36}(a-ck)^2 - f$$

$$\pi_M^A = \frac{1}{6}(a-ck)^2 \tag{9}$$

$$CS^A = \frac{1}{36}(a-ck)(a+5ck)$$

Under the fundamental assumption that the market size is significantly larger than the advertising cost ($a > c^2k^2$), we obtain:

$$\pi_0^A - \pi_0^N = \frac{1}{36}(a-ck)(a-7ck) - \frac{a^2}{64} = \frac{7a^2}{576} - \frac{2ack}{9} + \frac{7c^2k^2}{36} > 0 \tag{10}$$

$$\pi_1^A - \pi_1^N = \frac{1}{36}(a-ck)^2 - \frac{a^2}{64} = \frac{1}{576}(a-4ck)(7a-4ck) > 0 \tag{11}$$

$$\pi_M^A - \pi_M^N = \frac{1}{6}(a-ck)^2 - \frac{a^2}{8} = \frac{1}{24}(a^2 - 8ack + 4c^2k^2) > 0 \tag{12}$$

$$CS^A - CS^N = \frac{1}{36}(a-ck)(a+5ck) - \frac{a^2}{32} = -\frac{1}{288}(a^2 - 32ack + 40c^2k^2) < 0 \tag{13}$$

Based on the above comparisons, it is found that under the advertising efforts of retail firms, profits of all upstream and downstream firms increase while consumer surplus decreases, benefiting wholesale and retail firms but harming the consumers. Since retail firms engaging in advertising efforts bear the cost of advertising product differentiation, they obtain less profit relative to those not engaging in advertising efforts. This results in a second mover advantage in advertising competition. With fewer profit incentives, firms may adopt a strategy of advertising laggards by differentiating their advertising efforts. Quantity competition results in price competition under advertising behavior, and wholesalers, when profitable, encourage firms to engage in advertising competition to achieve product retail channel differentiation and increase their own profits. Consequently, Proposition 1 is obtained:

Proposition 1: *Under the advertising efforts of retail firms, profits of all wholesale and retail firms increase while consumer surplus decreases, benefiting firms but harming the consumers. Retail firms engaging in advertising efforts bear the cost of advertising differentiation and obtain less profit relative to those not engaging in advertising efforts, forming a second mover advantage. Firms tend to adopt advertising laggard strategies to gain a second mover advantage, and wholesalers, when profitable, encourage firms to engage in advertising games to achieve product retail channel differentiation and increase their own profits.*

Based on Proposition 1, it is known that consumer welfare suffers due to channel differentiation. Whether there is a change in social welfare due to advertising can be inferred from the analysis in the second section. Under the scenario where

retail firms do not exert advertising efforts, their social welfare level is denoted by *N*. Meanwhile, the social welfare level under retail firms' advertising efforts is denoted by *A*, and they are respectively represented by:

$$SW^N = \frac{3a^2}{16} - 2f + I$$

$$SW^A = \frac{1}{4}(a - ck)^2 - 2f + I$$

We obtain that

$$SW^A - SW^N = \frac{1}{4}(a - ck)^2 - \frac{3a^2}{16} = \frac{1}{16}\left(a^2 - 8ack + 4c^2k^2\right) > 0 \quad (14)$$

The results indicate that retail firms engaging in advertising to differentiate their channels will elevate the level of social welfare. Hence, the government should encourage retail firms to participate in advertising competition in order to enhance social welfare.

Proposition 2 is inferred:

Proposition 2: *Retail firms engaging in advertising to differentiate their channels will increase the level of social welfare.*

The result of Proposition 2 indicates that advertising behavior by retail firms, which links to channel differentiation, is beneficial for overall social welfare, advocating a positive attitude towards advertising behavior.

4. Conclusion and Management Implications

In this paper, firm advertising behavior emerges as a crucial factor in market segmentation. The study finds that while advertising benefits the firms engaging in it, their profits are not as high as those of non-advertising firms, leading to a situation of second-mover advantage, where quantity competition turns into price competition under advertising behavior. Advertising not only boosts the profits of the firms themselves but also spills over to benefit all retail and upstream wholesale firms, potentially encouraging market advertising competition. However, advertising behavior, which results in channel branding or market segmentation, inevitably harms consumer welfare by reducing consumer surplus. Nonetheless, it can elevate the overall level of social welfare. Regulatory agencies may find it necessary to intervene with policies aimed at protecting and compensating consumers. The analytical findings of our study can serve as valuable references for relevant policy formulation.

The analysis in this paper assumes that wholesale firms delegate downstream retail channel pricing to retail firms, which determine retail prices based on market segmentation through advertising. However, in practice, wholesale firms may still influence final retail prices through brand management and marketing efforts. It is a common understanding in society that downstream dominant market retail channel firms engage in their own marketing efforts, resulting in the perception of the same product as different commodities in different channels. Ad-

ditionally, differences in warranty conditions and after-sales services for the same product are also considered efforts towards product differentiation. For their own interests, wholesale firms should encourage marketing efforts by retail firms. According to the analysis in this paper, although such efforts may not benefit consumers directly, they still contribute to overall social welfare through product differentiation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

Choi, S. C. (1991). Price Competition in a Channel Structure with a Common Retailer. *Marketing Science, 10,* 271-296. https://doi.org/10.1287/mksc.10.4.271

Choi, S. C. (1996). Price Competition in a Duopoly Common Retailer Channel. *Journal of Retailing, 72,* 117-134. https://doi.org/10.1016/s0022-4359(96)90010-x

Dorfman, R., & Steiner, P. O. (1954). Optimal Advertising and Optimal Quality. *American Economic Review, 44,* 826-836.

Gerstner, E., & Hess, J. J. (1991). A Theory of Channel Price Promotions. *American Economic Reviews, 81,* 872-886.

Jeuland, A. P., & Shugan, S. M. (1988). Note—Channel of Distribution Profits When Channel Members Form Conjectures. *Marketing Science, 7,* 202-210. https://doi.org/10.1287/mksc.7.2.202

Lee, E., & Staelin, R. (1997). Vertical Strategic Interaction: Implications for Channel Pricing Strategy. *Marketing Science, 16,* 185-207. https://doi.org/10.1287/mksc.16.3.185

Liu, B., Cai, G., & Tsay, A. A. (2014). Advertising in Asymmetric Competing Supply Chains. *Production and Operations Management, 23,* 1845-1858. https://doi.org/10.1111/poms.12090

McGuire, T. W., & Staelin, R. (1983). An Industry Equilibrium Analysis of Downstream Vertical Integration. *Marketing Science, 2,* 161-191. https://doi.org/10.1287/mksc.2.2.161

Prabhu, J., & Tellis, G. J. (2000). Do Consumers Ever Learn? Analysis of Segment Behavior in Experimental Markets. *Journal of Behavioral Decision Making, 13,* 19-34. https://doi.org/10.1002/(sici)1099-0771(200001/03)13:1<19::aid-bdm334>3.0.co;2-z

Raju, J. S., Sethuraman, R., & Dhar, S. K. (1995). The Introduction and Performance of Store Brands. *Management Science, 41,* 957-978. https://doi.org/10.1287/mnsc.41.6.957

Shugan, S. M. (1985). Implicit Understandings in Channels of Distribution. *Management Science, 31,* 435-460. https://doi.org/10.1287/mnsc.31.4.435

Tyagi, R. K. (1999). A Characterization of Retailer Response to Manufacturer Trade Deals. *Journal of Marketing Research, 36,* 510-516. https://doi.org/10.1177/002224379903600409

Tyagi, R. K. (2005). Do Strategic Conclusions Depend on How Price Is Defined in Models of Distribution Channels? *Journal of Marketing Research, 42,* 228-232. https://doi.org/10.1509/jmkr.42.2.228.62290