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# **Differentiation Strategy for Firms: Online Ad versus Mass Media Ad**

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## **Abstract**

This study analyzes advertiser firms' product differentiation strategies and the relationship two media advertising effect, mass media and online media. We derive an inverse demand function from the utility function relating to the evaluation of the goods' additional information that consumers obtain from advertisements, and we analyze the advertising choices of firms using a two-stage decision-making model. The analysis results indicate that firms choose asymmetric advertising to take advantage of the interdependent effects of two advertising and differentiation and to increase profit through rivals' advertising effects. However, the profits of firms are the highest when both firms choose the discriminatory online media advertising. Social welfare is highest in symmetric choice of the discriminatory online advertising, but consumer surplus is highest in symmetric choice of the discriminatory mass media advertising.

## **Key Words:**

Online media advertising, Mass media advertising, Targeting, Differentiation Strategy, Interaction

## Introduction

The rapid development of communication technology has made it possible to some extent to understand consumer behavior, which was technically impossible with traditional mass media. The understanding of consumer behavior on the Internet has led to the growth of online media advertising, which has the advantage of being able to provide information tailored to each individual consumer. These online media have also drastically changed consumer behavior, the advertising strategies of the advertisers. Changes in major advertising media are reflected in ad sales: in 2020, five online media tech companies-Google, Facebook, Alibaba, Bytedance (TikTok), and Amazon-will contribute \$296 billion in ad sales, representing 46% of the ad market. In 2010, they accounted for only 17%.<sup>1</sup> Tech companies are attracting more people and expanding their target audience with engaging content, images, and videos on their networks. Traditional media firms, such as Corp, Fox, Comcast, Verizon, Viacom, CBS, and RTL, will need new advertising strategies to compete with these online media advertising. However, some believe that online media advertising, which focuses on such targeting methods, has limited growth because it is limited to stereotypical consumption.<sup>2</sup> In recent studies, Goldfarb and Tucker (2011) showed a substitutable relationship between online media advertising and mass media advertising. De Vries et al. (2017) stated that advertising with social messages and other media complements the traditional advertising effectiveness. Indeed, the advertising strategy of Toyota, which is transforming itself from an automaker to a mobility firm, is to “gain broad recognition on TV and convey more in-depth information online.”<sup>3</sup>

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<sup>1</sup> See PressGazette (2020) “Quintopoly? Five tech companies now earn 46% of global ad revenues as news media left behind,” (URL: <https://pressgazette.co.uk/global-advertising-spend-2020-quintopoly/>, browsed on 12/03/22)

<sup>2</sup> See Nikkei Business (2021) “Is Targeted Advertising by U.S. Tech Giants Really Effective?” (URL: <https://business.nikkei.com/atcl/NBD/19/world/00343/>, browsed on 12/03/22)

<sup>3</sup> See Nikkei Trend (2020) “Behind the Scenes of "TOYOTIMES" Production: TV Commercials Become Owned Media,” (URL: <https://xtrend.nikkei.com/atcl/contents/18/00344/00006/> browsed on 12/03/22)

Thus, recent advertising studies have investigated the impact of online advertising on consumers, targeting capabilities, and cost comparisons, as Goldfarb (2014) pointed out the difference in targeting costs between online and offline advertising. In addition, several authors, such as Du et al. (2017) and Liaukonyte et al. (2015), have explored the relationship between online and mass media advertising; Dukes (2004) found that the level of advertising in non-differentiated goods markets was higher. Iyer et al. (2005), on the other hand, found that firms differentiate by dividing consumers into two groups through advertising messages. From these studies, it is necessary to analyze not only the change from mass media-centered advertising to advertising through online media, but also the situation in which advertisers, firms, are selecting advertising media while considering product differentiation and the interrelationship between the two media. Therefore, this paper analyzes the relationship between two types of media advertising, mass media advertising and online media advertising, and the differentiation strategies of the firms.

As a method of analysis, we choose a two-stage game in a duopoly market. Given the advertising effectiveness, the two firms choose the type of advertising and the degree of goods differentiation in the first stage. In the second stage, both firms engage in Cournot competition.

The results of the analysis indicate that firms try to gain higher profits by exploiting the two media demand effect and increasing the competitive effect or differentiating. That is, when advertising effectiveness is low, one firm chooses discriminatory mass media advertising, and another chooses discriminatory Internet media advertising. When advertising effectiveness is high, firms try to increase their profits through homogeneity of goods through the two media advertisements. One firm chooses homogeneous mass media advertising, and the other chooses homogeneous online media advertising. Thus, the rational choice of firms is an asymmetric choice rather than a symmetric one. However, the optimal advertising strategy for both firms is

discriminatory online media advertising. Through the additional information, advertising increases consumers' valuation of goods and social welfare. However, the magnitude of producer surplus and consumer surplus depends on the type of advertising and differentiation. When advertising effects are small, the choice of differentiated online media advertising increases both consumer surplus and social welfare more than homogeneous mass media advertising.

The remainder of this paper is organized as follows. Section 2 reviews relevant previous studies. Section 3 describes the assumptions and setup of the model. Section 4 examines three advertising strategies to establish the optimal advertising strategy and looks for the optimal advertising choices for both firms in equilibrium. Section 5 discusses the appropriate advertising strategy for the firms, including social welfare. Finally, Section 6 concludes the paper.

## **2. Literature review**

Numerous studies have been conducted on the impact of advertising regulations, differences in advertising techniques, and the relationship between information and types of advertising. For instance, Kerr et al. (2015) showed that traditional advertising theories studied in mass media environments are equally applicable in online environments. De Vries et al. (2017) stated that traditional advertising, that is, mass media advertising, is the most effective for both brand building and customer acquisition. Meanwhile, advertising with social messages and other media complements the traditional advertising effectiveness. In an advertising study dealing with goods differentiation, Grossman and Shapiro (1984) analyzed why firms focus on advertising in a mass media environment. Chen and Whinston (2011) determined that standout advertising is undesirable for firms with a competitive advantage. Furthermore, Goldfarb and Tucker (2011) found that the online and mass media advertising relationship is alternative.

Regarding targeting, Goldfarb (2014) showed that the fundamental difference between

online and offline advertising lies in the reduction of the cost of targeting. Meanwhile, Crampes et al. (2009) showed that both advertising and customers finance media platforms. Moreover, Johnson (2013) analyzed how the increased ability of targeted advertising (i.e., advertising for specific individuals) affects consumers' advertising avoidance. Bergemann and Bonatti (2011) showed that in the advertising market, offline and online media interactions lead to a decrease in revenue for offline media. Furthermore, Boerman et al. (2017) showed that online advertising gives advertisers control over the level of personalization and consumers control over their ability to acquire information. Chen et al. (2019) analyzed consumer reactance to online personalized advertising and found that it is mediated by individual rational choice factors. Esteves (2009) examined the informational effects of advertising in a homogeneous goods market where firms evaluate the effects of price discrimination with efficient advertising. Focusing on the dynamic effects of customer pointing, they studied the dynamic effects of customer pointing. Moreover, Esteban and Hernández (2017) studied the market interaction between pricing and informational advertising, which basically consists of two types of advertising: opt-in advertising and direct advertising without permission. Furthermore, Chutani and Sethi (2012) studied durable consumer goods in a duopoly market between competing retailers and firms producing durable goods. Meanwhile, the present study examined how firms employ different advertising to maximize profits, drawing on Dukes (2004) and Iyer et al. (2005), who analyzed the impact of targeting on the supply and price of advertising.

### **3. Model**

Two firms in the market produce goods at a marginal cost  $c$ . For simplicity, assume marginal cost  $c = 0$ . Each firm maximizes its profit by differentiating its goods through advertising, which is of two types: online media advertising and mass media advertising. Let  $g$  and  $b$  be the differentiation effect when the firm uses mass media advertising and online media advertising, respectively.

Moreover, let  $b, g < (0, 1)$ .  $b$  and  $g$  represent the degree to which consumers value the diversity of goods. Simultaneously, it represents the degree of differentiation of goods: the smaller the  $b$  or  $g$ , the greater the degree of differentiation of the two goods, and the larger the  $b$  or  $g$ , the smaller the degree of differentiation. The consumer obtains the value of  $e$  ( $0 < e < a$ ) from the advertisement in addition to  $a$  ( $>0$ ) obtained from the good.  $e$  is assumed to be the same for all consumers. This differentiating effect affects the additional valuation  $e$  of the good. This demand structure is based on Foros (2004). Denote the quantity of goods produced by firm  $i$  ( $i = 1, 2$ ) as  $q_i$  ( $i = 1, 2, i \neq j$ ).

The analysis method uses a two-stage game with the following procedure:

- First stage: Each firm decides the type of advertising and the degree of differentiation of goods.
- Second stage: The two firms compete in Cournot competition.

By solving this two-stage game with backward induction, we find the optimal advertising choice for each firm.

### 3.1 Demand side

A dense population of consumers in the market has the same type of utility function  $U(q_i, q_j)$  in the range  $(0, 1)$ .  $e$  is affected by the degree of differentiation by advertising. When two firms use mass media advertising, the consumer's valuation of the good is affected by the degree of differentiation. Thus, consumers' utility from goods 1 and 2 is expressed as follows:

$$U_m(q_1, q_2) = (a + be)(q_1 + q_2) - (q_1^2 + 2bq_1q_2 + q_2^2)/2 \quad (1)$$

where  $a$ ,  $b$ , and  $e$  are the parameters. The subscript  $m$  indicates utility under mass media advertising. Consumers are price-takers; hence, given the price  $p_i$  of good  $i$ , each demand quantity is determined to maximize consumer surplus  $CS_m = U_m(q_i, q_j) - p_iq_i - p_jq_j$ . From the maximization

condition of consumer surplus  $CS_m$ , the inverse demand function for good  $i$  is as follows:

$$p_i(q_i, q_j) = a + be - q_i - bq_j \quad (2)$$

When both firms use online advertising, the consumer utility obtained from goods 1 and 2 takes the same form as in Equation (1), but  $b$  is replaced by  $g$ . The subscript  $o$  indicates utility under online media advertising. From the maximization condition for consumer surplus  $CS_o = U_o(q_i, q_j) - p_i q_i - p_j q_j$ , the inverse demand function for good  $i$  is

$$p_i(q_i, q_j) = a + ge - q_i - gq_j \quad (3)$$

If firm  $i$  uses online media advertising and firm  $j$  uses mass media advertising, the consumer's utility from goods 1 and 2 is replaced by  $b$  and  $g$ , respectively. The consumer utility  $U_a(q_i, q_j)$  is calculated as follows:

$$U_a(q_i, q_j) = (a + be)q_i + (a + ge)q_j - [q_i^2 + (b + g)q_i q_j + q_j^2]/2 \quad (4)$$

Subscript  $a$  indicates asymmetric advertising choices of firms. From the maximization condition of consumer surplus  $CS_a = U_a(q_i, q_j) - p_i q_i - p_j q_j$ , the inverse demand function for good  $i$  is

$$p_i(q_i, q_j) = a + be - q_i - q_j(b + g)/2 \quad (5)$$

$$p_j(q_i, q_j) = a + ge - q_i(b + g)/2 - q_j \quad (6)$$

### 3.2 Supply side

The decision-making problem of a firm predicting consumer demand can be expressed as follows. Suppose that when mass media advertising is used, the effectiveness of the advertising depends on the fixed cost to be determined. In this case, a fixed cost of  $fe^2/2$  is incurred. If we set  $f=1$  for simplicity, the decision-making problem of firm  $i$  is



$$\max_{q_i} \pi_i = q_i p_i - e^2/2 \quad (7)$$

When firm  $i$  uses online advertising, it incurs an advertising cost of  $\gamma$  per unit of goods. Assuming  $\gamma$  is constant, firm  $i$ 's decision-making problem is

$$\max_{q_i} \pi_i = q_i(p_i - \gamma) \quad (8)$$

#### 4. An optimal advertising strategy for both firms

This section analyzes the best media advertising and differentiation strategies for the two firms. When firm  $i$  anticipates ad types and differentiation of rival firm  $j$ , firm  $i$  decides the degree of differentiation and chooses the type of advertising, that is, mass media or online media advertising. This choice is the same for firm  $j$ . Thus, the two firms that predict the behavior of each other's rivals have four combinations of strategies (Table 1). In Table 1, we analyze the firms' choices by considering three possible combinations that the firms could take: both firms choose mass media advertising with the same differentiation (Case 1), both firms choose online media advertising the same differentiation (Case 2), and both firms make asymmetric choices of different differentiation and advertising than the rival (Case 3).

Table 1. Both firms' advertisement strategies in online and mass media

Firm $i \setminus$ Firm $j$	<i>Mass Media</i>	<i>Online Media</i>
<i>Mass Media</i>	$\pi_i^m(e, g), \pi_j^m(e, g)$	$\pi_i^{am}(e, b, g), \pi_j^{ao}(e, b, g)$
<i>Online Media</i>	$\pi_i^{ao}(e, b, g), \pi_j^{am}(e, b, g)$	$\pi_i^o(e, b), \pi_j^o(e, b)$

##### 4.1. Case 1: Both firms choose mass media advertisement $m$

###### Second stage: Maximization problem

When both firms are active during the period, Equation (2) yields the following:

$$p_i^m = a + eg - q_i - gq_j \quad (9)$$

$$p_j^m = a + eg - gq_i - q_j \quad (10)$$

Regarding a given  $q_j$ , from Equations (9) and (10), firm  $i$  solves the following problems:

$$\max_{q_i} \pi_i^m = q_i \cdot p_i^m - e^2/2 \quad (11)$$

$$\max_{q_j} \pi_j^m = q_j \cdot p_j^m - e^2/2. \quad (12)$$

$$\text{s.t } \pi_i^m \geq 0$$

Solving firm  $i$ 's maximization problems in Equations (11) and (12), we derive

$$q_i^{m*} = (a + eg)/(2 + g). \quad (13)$$

As  $\pi_i^m \geq 0$ , the upper bound on the advertising effectiveness  $e$  in this paper is

$$\bar{e} = 2a^2/(-ag + \sqrt{2}\sqrt{a^2(2 + g)^2}) \quad (14)$$

## 4.2. Case 2: Both firms adopt online advertisement $o$

### Second stage: Maximization problem

When both firms adopt the same online advertisement, the firms' maximization problems are represented as follows:

$$\max_{q_i} \pi_i^o = q_i (p_i - \gamma) = q_i (a + be - q_i - bq_j - \gamma). \quad (15)$$

The superscript  $o$  indicates both firms' adoption of online advertising. Solving the firm's maximization problem, we have

$$q_i^{o*} = (a + be - \gamma)/(2 + b). \quad (16)$$

Substituting  $q_i^o$  into Equation (4), we obtain

$$p_i^{o*} = (a + b(e + \gamma) + \gamma)/(2 + b) \quad (17)$$

Note that superscript  $*$  indicates an equilibrium value.

**4.3. Case 3: Firm  $i$  and firm  $j$  adopt mass media advertisement  $am$  and online advertisement  $ao$ , respectively**

**Second stage: Maximization problem**

When both firms are active, we derive:

$$p_i^{am} = a + be - q_i - q_j (b + g)/2 \quad (18)$$

$$p_j^{ao} = a + eg - q_i (b + g)/2 - q_j \quad (19)$$

Regarding a given  $q_{ij}$ , from Equations (18) and (19), firm  $I$  solves the following problems:

$$\max_{q_i} \pi_i^{ao} = q_i (p_i^{ao} - \gamma) = q_i (a + be - q_i - q_j (b + g)/2 - \gamma) \quad (20)$$

$$\max_{q_j} \pi_j^{am} = q_j \cdot p_j^{am} - e^2/2 = q_j (a + eg - q_i (b + g)/2 - q_j) - e^2/2. \quad (21)$$

The superscript  $ao$  denotes that firm  $i$  introduces online advertising, whereas the superscript  $am$  denotes that firm  $j$  introduces online advertising. Solving the maximization problem (20) and Equation (21) for both firms, we obtain

$$q_i^{ao*} = 2(a D_1 + 4 \gamma + e(b(4-g)-g^2))/D_1 D_2 \quad \text{and} \quad (22)$$

$$q_j^{am*} = (\gamma + 2(2-b)e)/D_1 + (2a - \gamma - 4e)/D_2. \quad (23)$$

We set  $D_1 \equiv (4 - b - g)$  and  $D_2 \equiv (4 + b + g)$ . After substituting  $q_i^{am}$  and  $q_j^{ao}$  into Equations (18) and (19), respectively, we derive the following:

$$p_i^{ao*} = \gamma + 2e - (\gamma + 2(2-b)e)/D_1 + (2a - \gamma - 4e)/D_2 \quad \text{and} \quad (24)$$

$$p_j^{am*} = (\gamma + 2(2-b)e)/D_1 + (2a - \gamma - 4e)/D_2. \quad (25)$$

**5. Optimal advertising and social welfare for firms**

**5.1. Optimal advertising for firms**

Based on the analysis of three cases above, let us consider the advertising choices of firms from the following six case divisions.<sup>4</sup> This analysis takes  $e$  as a given parameter; thus, we do not consider the optimal  $e$  for the firm. Also, assume that both firms try to differentiate their goods in advertising, so given that both firms differentiate from each other.

Case study (1):  $e = 0.35$ , and firm  $j$  chooses discriminatory mass media advertising with  $g = 0.3$ . If firm  $i$  chooses discriminatory online media advertising,  $\pi_i^m(g, e) < \pi_i^{ao}(b, g, e)$ , it chooses an asymmetric choice.

Case study (2):  $e = 0.35$ , firm  $j$  chooses discriminatory online media advertising with  $b = 0.2$ . If firm  $i$  chooses homogeneous mass media advertising with  $0.87 < g < 1$ , then  $\pi_i^o(b, e) < \pi_i^{am}(b, g, e)$ . In this case, firm  $i$  makes an asymmetric choice. Meanwhile, if firm  $i$  chooses a discriminatory mass media advertisement with  $0 < g < 0.87$ , then  $\pi_i^o(b, e) > \pi_i^{am}(b, g, e)$ . Firm  $i$  makes a symmetric choice.

Case study (3):  $e = 0.1$ , and firm  $j$  chooses a discriminatory mass media advertisement with  $g = 0.3$ . If firm  $i$  chooses discriminatory online media advertising with  $0 < b < 0.2$ , then  $\pi_i^m(g, e) < \pi_i^{ao}(b, g, e)$ . Firm  $i$  makes an asymmetric choice. Meanwhile, if firm  $i$  chooses a discriminatory online media advertisement with  $0.2 < b < 1$ , then  $\pi_i^m(b, e) > \pi_i^{ao}(b, g, e)$ . Firm  $i$  makes a symmetric choice.

Case study (4):  $e = 0.1$ , and firm  $j$  chooses a discriminatory online media advertisement with  $b = 0.2$ . If it chooses a discriminatory mass media ad with  $0 < g < 0.29$ ,  $\pi_i^o(b, e) < \pi_i^{am}(b, g, e)$ . Firm  $i$  makes an asymmetric choice. If firm  $i$  chooses a homogeneous mass media advertisement with  $0.29 < g < 1$ , then  $\pi_i^o(b, e) > \pi_i^{am}(b, g, e)$ , and firm  $i$  makes a symmetric choice.

Case study (5):  $e = 0.5$ , and firm  $j$  chooses a discriminatory mass media advertising with  $g = 0.3$ . If firm  $i$  chooses online media,  $\pi_i^m(g, e) < \pi_i^{ao}(b, g, e)$ , and it makes an asymmetric choice.

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<sup>4</sup> See Appendix Figures 1–6

Lastly, Case study (6):  $e = 0.5$ , and firm  $j$  chooses discriminatory online media advertising with  $b = 0.2$ . If firm  $i$  chooses homogeneous mass media advertising with  $0.76 < g < 1$ ,  $\pi_i^o(b, e) < \pi_i^{am}(b, g, e)$ . Firm  $i$  makes an asymmetric choice. Meanwhile, if firm  $i$  chooses a discriminatory mass media advertisement with  $0 < g < 0.76$ , then  $\pi_i^o(b, e) > \pi_i^{am}(b, g, e)$ . Firm  $i$  makes a symmetric choice. Thus, we obtain the following Lemma.

**Lemma 1:** When  $e$  is small, there are three equilibria: 1) both firms choose discriminatory online media advertising; 2) both firms choose discriminatory mass media advertising; 3) both firms choose asymmetric advertising and differentiation. when  $e$  is somewhat large, there are 2 equilibria: 1) both firms choose discriminatory online media advertising, and 2) both firms choose asymmetric advertising and homogenization.

When  $e = 0.5$ ,  $\partial \pi_i^{am}(e, b, g) / \partial g > 0$ . In this case, if firm  $j$  chooses discriminatory online media advertising, then firm  $i$  will choose different media, mass media, and provide homogeneous advertising, resulting in higher profits. If firm  $j$  chooses discriminatory mass media advertising,  $\partial \pi_i^{ao}(e, b, g) / \partial b > 0$ , then firm  $i$  chooses different media, online media, provides homogeneous advertising, and earns higher profits.  $e = 0.35$  is also similar. This is due to the mutual effect of substitutability of goods in different media from rivals, which increases demand. On the other hand, if  $e = 0.1$  and firm  $j$  chooses discriminatory online media advertising,  $\partial \pi_i^{am}(e, b, g) / \partial g < 0$ , then firm  $i$  chooses a different media, mass media, and earns higher profits with discriminatory advertising. If firm  $j$  chooses discriminatory mass media advertising,  $\partial \pi_i^{ao}(e, b, g) / \partial b < 0$ , so firm  $i$  chooses discriminatory online media advertising. This is the effect of using the interdependence effect of the two media to differentiate products and expand markets. In other words, consumers who get information about a car from Toyota's TV commercials will search for

it on the Internet and compare it with other firms' cars, so rival firms will offer homogeneous advertising. When the advertising effect is small, differentiated products through the two media have a complementary effect as an interdependence effect. This interdependence effect is found in Du et al. (2017), where the number of relevant online searches increases rapidly even when the number of viewers of TV ads is small. Therefore, we derive the following Lemma 2.

**Lemma 2:** The combination of mass media advertising and online media advertising can produce effect that complement each other or substitute each other's advertising, depending on the magnitude of the advertising effect.

Let us now consider symmetric and asymmetric choices. In (1) when  $e = 0.35$ , if firm  $j$  chooses discriminatory mass media advertising, firm  $i$  tries to take advantage of the alternative interdependence effect of advertising and obtain higher profits than symmetric choice, online media advertising. Therefore, it is unreasonable to make the discriminatory symmetric choice as a choice of firms seeking higher profit. For  $e = 0.35$  (2), if firm  $j$  emphasizes the differentiation of its goods through discriminatory online media advertising, then firm  $i$  will make a homogeneous asymmetric advertising choice to obtain higher profits by taking advantage of alternative interdependencies in advertising. In (3) and (4), when  $e = 0.1$  and firm  $j$  chooses advertising that emphasizes product differentiation, firm  $i$  will choose discriminatory asymmetric advertising in order to take advantage of the complementary effects of interdependence to reduce price declines and capture higher profits. If firm  $j$  performs discriminatory online media advertising, then firm  $i$  will choose discriminatory asymmetric advertising to obtain its complementary effect. Similarly, in cases (5) and (6) with  $e = 0.5$ , firm  $i$  will not choose discriminatory symmetric advertising given the alternative mutual effects. The same holds for

firm  $j$ 's choice, leading to the following proposition.

**Proposition 1:** When  $e$  is large, both firms use homogeneous advertising, one using online advertising and the other using mass media advertising; when  $e$  is small, both firms use differentiation strategies, one using online advertising and the other using mass media advertising.

## 5.2. Social welfare

To what extent do firms' advertising choices affect social welfare? Let us compare the magnitude under each firm's choice with a simple quantification: consumer surplus and total surplus when both firms choose mass media ( $TSm$ ); consumer surplus and total surplus when firms  $i$  and  $j$  chooses mass media and online media, respectively ( $TSa$ ); and consumer surplus and total surplus when both firms choose online media advertising ( $TSo$ ). From  $a = 1$ ,  $b = 0.2$ ,  $g = 0.3$ , and  $c = 0.02$ , we compare consumer, producer, and total surplus in three equilibria. The consumer surplus is  $CSo < CSa < CSm$ , and the total surplus is  $TSm < TSa < TSo$ . The producer surplus is  $\Pi_{i+j}^{m+m} < \Pi_{i+j}^{am+ao} < \Pi_{i+j}^{o+o}$ .<sup>5</sup> Meanwhile, for  $e = 0.1$  and  $g = 0.3$ ,  $TSm < TSa < TSo$  with  $0 < b < 0.24$ ,  $TSo < TSa < TSm$  with  $0.24 < b < 1$ . The producer surplus is  $\Pi_{i+j}^{m+m} < \Pi_{i+j}^{am+ao} < \Pi_{i+j}^{o+o}$  for  $0 < b < 0.28$ , and  $\Pi_{i+j}^{o+o} < \Pi_{i+j}^{am+ao} < \Pi_{i+j}^{m+m}$  for  $0.28 < b < 1$ . For  $e = 0.35$ , regardless of the magnitude of  $b$ ,  $\Pi_{i+j}^{m+m} < \Pi_{i+j}^{am+ao} < \Pi_{i+j}^{o+o}$  and  $TSm < TSa < TSo$ , but the consumer surplus is  $CSm < CSa < CSo$  for  $0 < b < 0.37$ ,  $CSo < CSa < CSm$  for  $0.37 < b < 1$ .<sup>6</sup>

<sup>5</sup>  $\Pi_{i+j}^{m+m} \equiv \pi_i^m + \pi_j^m$ ,  $TS = CS + \Pi_{i+j}$

<sup>6</sup> See Appendix Graphs 7 ~ 12.

**Lemma 3:** When  $e$  is small, the total surplus and producer surplus are in the order of  $TSm < TSa < TSo$  with  $b < g$ , and  $TSo < TSa < TSm$  with  $g < b$ . The consumer surplus is  $CSo < CSa < CSm$ . Meanwhile, when  $e$  is somewhat large, the total surplus and producer surplus are  $TSm < TSa < TSo$ . The consumer surplus is in the order of  $CSo < CSa < CSm$  with  $g < b$ , and  $CSm < CSa < CSo$  with  $b < g$ .

Based on the results presented, when  $e$  is small, consumer surplus is larger for mass media ads with demand effectiveness, regardless of differentiation. However, because differentiation changes producer surplus through demand effectiveness, total surplus changes depending on the degree of differentiation between the two ads. However, when  $e$  is large, the symmetric choice of price-effective online media ads has a higher producer surplus than the asymmetric choice, regardless of the degree of differentiation, and the total surplus is also higher. However, the consumer surplus of the symmetric online media choice with large price effectiveness is the lowest compared to the other choices.

## 6. Concluding remarks

Using a theoretical model, this study analyzes the relationship of differentiation and the advertiser firms' choice of mass media advertising or online media advertising. The analysis revealed firms seek to increase their own profits by taking advantage of their rivals' advertising effect (externalities) and own advertising effect. Thus, both firms choose asymmetric advertising over symmetric advertising choices.

Online media advertising has experienced impressive growth in recent years. However, since two media provide advertising externality each other, two media exist together, and



change each other by an interdependent effect. Therefore, firms aim to maximize their profits and demand expansion not only through the effectiveness of their online media, but also through advertising combined with mass media. The results of this analysis complement those of De Vries et al. (2017), in which the harmonization of traditional ad and the firm's social media activities improve the firm's performance concerning brand building and customer acquisition promotion. However, advertiser firms' asymmetric selection is a Nash equilibrium, since symmetric selection of online media advertising allows firms to generate higher profits.

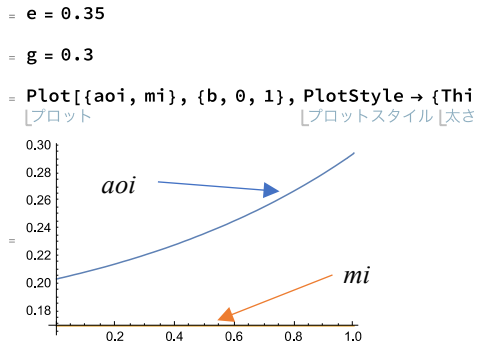
This paper analyzed a model in which online media ads costs are held constant and advertising effectiveness and costs are related to mass media ads with TV commercials in mind. However, in the future, we would like to employ a model that considers the fact that online media ads costs also depend on the production or advertising demand and change. We will also analyze how cost and differentiation affect ads choices.

## **Acknowledgement**

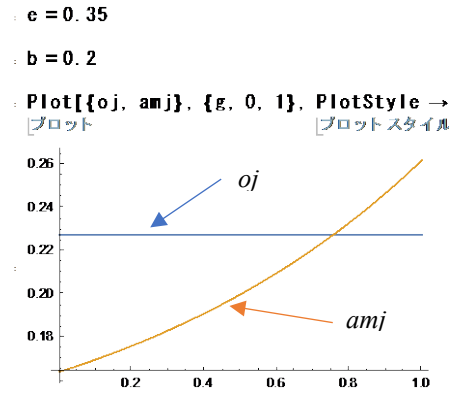
This research is partially supported by Grant-in-Aid for Scientific Research(C) (19K01688, 22K01512) and Telecommunications Advancement Foundation (FY2020).

## Appendix

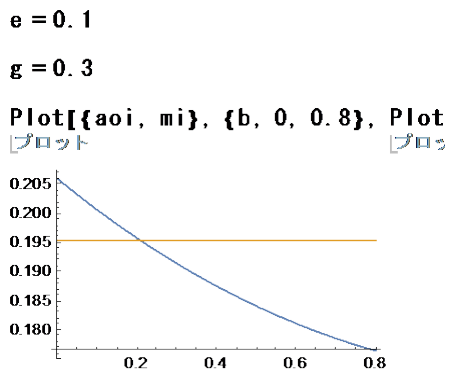
Comparison of firm's profit for two advertising choices.



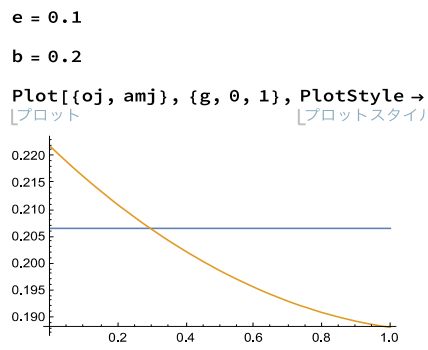
The above graph 1 shows Case 1.



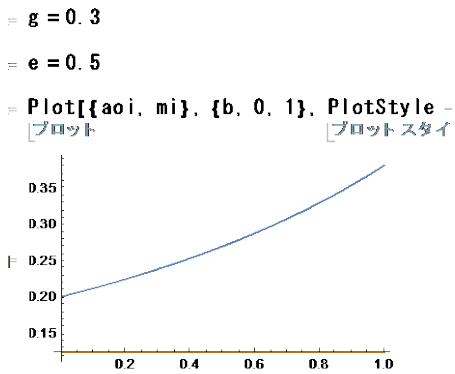
The above graph 2 shows Case 2.



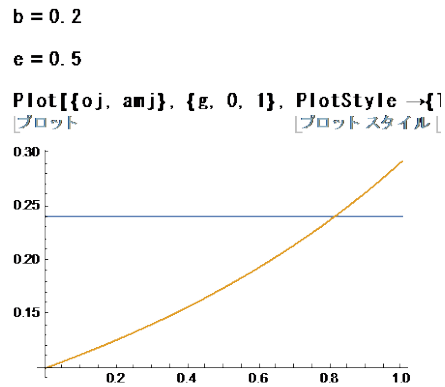
The above graph 3 shows Case 3.



The above graph 4 shows Case 4.

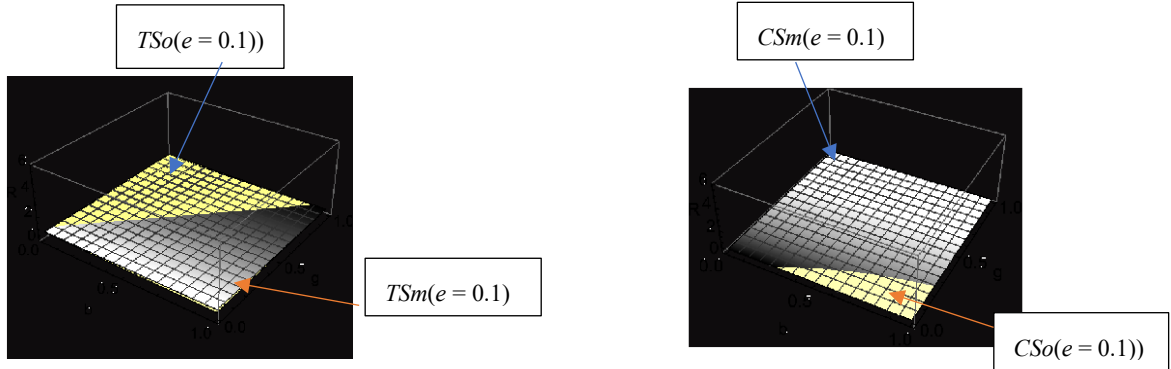


The above graph 5 shows Case 5.



The above graph 6 shows Case 6.

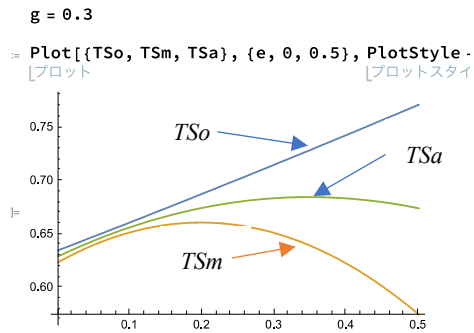
**Total surplus and Consumer surplus:**  $a = 1, c = 0.02,$



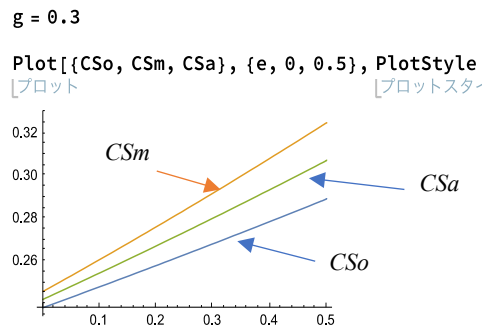
graph 7: Total surplus

graph 8: Consumer surplus

when  $a = 1, c = 0.02, b = 0.2.$

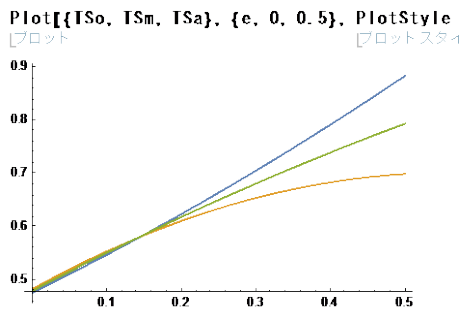


graph 9: Total surplus

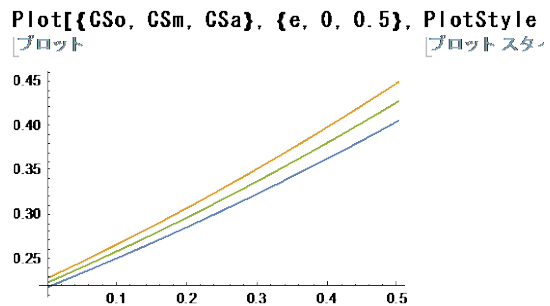


graph 10: Consumer surplus

when  $a = 1, c = 0.03, g = 0.8, b = 0.7$



graph 11: Total surplus



graph 12: Consumer surplus

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