MEMORANDUM

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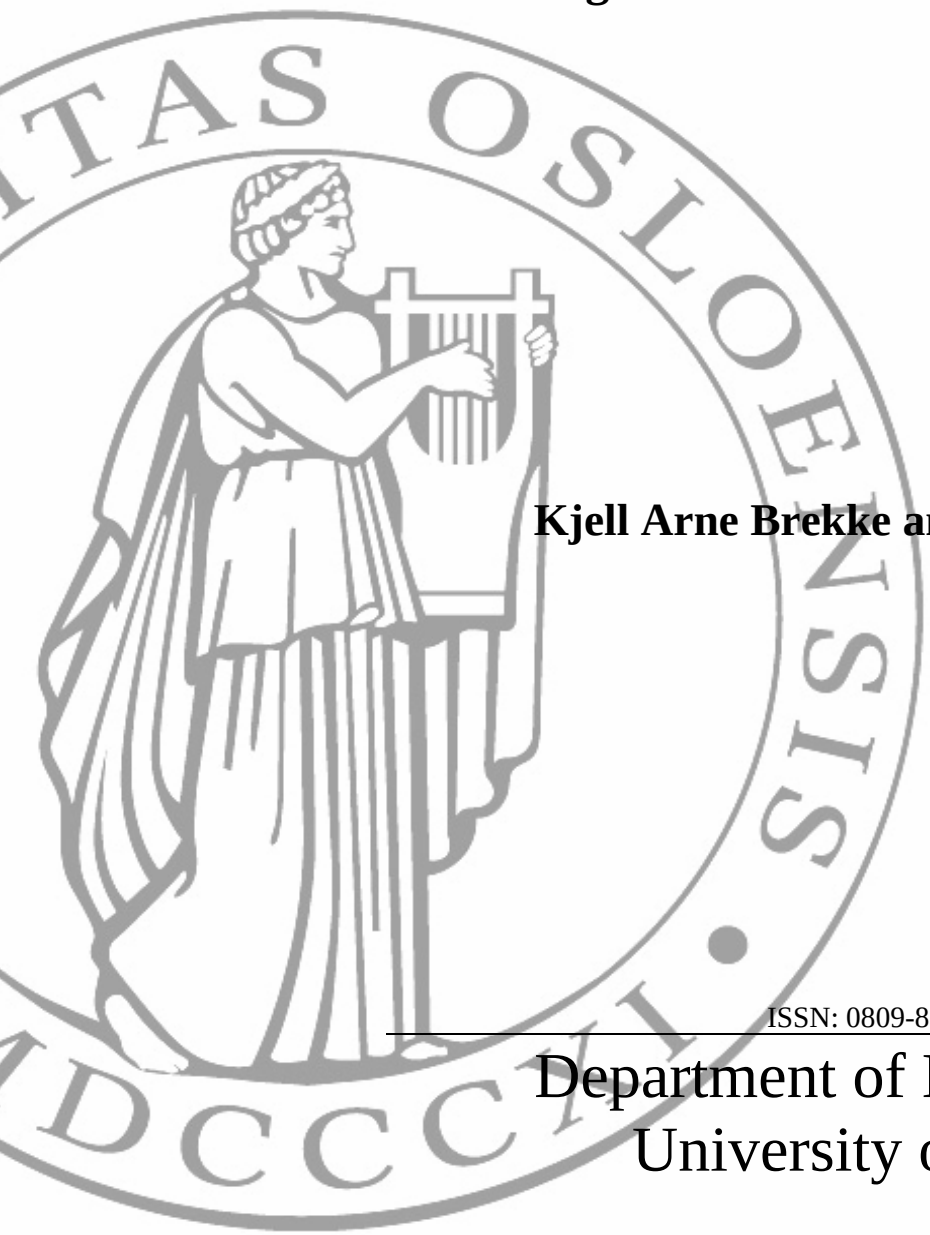
Advertising as a Distortion of Social Learning



Kjell Arne Brekke and Mari Rege

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Department of Economics
University of Oslo

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University of Oslo
Department of Economics

P. O.Box 1095 Blindern
N-0317 OSLO Norway
Telephone: + 47 22855127
Fax: + 47 22855035
Internet: http://www.oekonomi.uio.no/
e-mail: econdep@econ.uio.no

In co-operation with
The Frisch Centre for Economic Research

Gaustadalleén 21
N-0371 OSLO Norway
Telephone: +47 22 95 88 20
Fax: +47 22 95 88 25
Internet: http://www.frisch.uio.no/
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Advertising as a Distortion of Social Learning

Kjell Arne Brekke and Mari Rege*

November 14, 2006

Abstract

By combining a theory of herding behavior with the phenomenon of availability heuristic, this paper shows that non-informative advertisements can affect people's choices by influencing their perception of product quality. We present a model in which people can learn about product quality by observing the choices of others. Consumers are, however, not able to fully distinguish between the observations of real people and fictitious characters in advertisements. Even if a person is aware of this limitation and updates his beliefs accordingly, it is still rational for him to choose the product he has observed most often. In equilibrium the most observed product is always most likely to be of the highest quality. The analysis has important policy implications.

JEL Classification Numbers: D21, L15, M37

Keywords: Advertising, availability heuristic, herding behavior, information, product quality

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1 Introduction

It is striking how a vast majority of advertisements can be characterized as non-informative in the sense that they simply show happy people using a certain product but give no useful information about the product's attributes. These non-informative advertisements do, however, have one thing in common -they make the viewer familiar with the brand of the product by repetition of the brand name. How can this type of advertising affect people's behavior? By combining a theory of herding behavior with the phenomenon of availability heuristic, this paper shows that non-informative advertisements can affect people's choices by influencing their perception of product quality. The non-informative advertisements induce people to believe that the advertised product is of higher quality by making them more familiar with the product.

Often when people choose between different brands of a product, they do not know which brand is of the highest quality. In these situations, people may adopt the product that they observe most others have adopted. Such behavior can be rational if the choices of others yield information about product quality. This phenomenon, referred to as herding behavior, is elegantly captured in several economic models (Banerjee 1992, Bikhchandani et al. 1992, and Samuelson 2003). Moreover, it has been detected in experimental studies (Anderson and Holt 1997) and empirical investigations (see survey by Bikhchandani et al. 1998).

Tversky and Kahneman (1973) propose that people infer the prevalence of an event "from the ease with which the event can be recalled or imagined." That is, a person who feels that one product seems more familiar than the other, infers that he must have seen the familiar product more often. This phenomenon is called the availability heuristic and has been supported by several experimental studies (see Schwarz and Vaughn 2002) and empirical investigations (Schrum 1999). The availability heuristic suggests that people are not able to fully distinguish between observations of real people and fictitious characters in advertisements. A person presented with a choice between two products may feel that one is more familiar than the other. He is, however, not able to fully detect whether this is due to exposure to advertisements. Thus, combining the phenomenon of

availability heuristic with a theory of herding behavior suggests that firms can influence people's perceptions of product quality by making them more familiar with their products. This can be done by exposing people to images of others using their products in advertisements.

Based upon the phenomena of herding behavior and availability heuristic, we present a model in which people learn about product quality by observing the choices of others but are not able to fully distinguish between observations of real people and fictitious characters in advertisements. People are, however, fully aware of this limitation, and update their beliefs accordingly. The analysis shows that even if a person knows that his observations of others may be distorted by observations of fictitious characters in advertisements, it is still rational for this person to choose the product that he has observed most often. In equilibrium this product is always most likely to be of the highest quality. This is because if advertising biased observations to the extent that it would no longer be optimal to act in accordance with observations, then firms would no longer have incentives to advertise.

Legislators have long been concerned about regulating advertising because they are worried that advertising can bias important consumer choices[1]. In order to evaluate the impact of legislators' effort to regulate advertising it is important to understand how advertising affects people's choices. Interestingly, our model of advertising as distortion of social learning suggests that the degree to which advertising bias consumers' decisions is limited for two reasons: Firstly, firms engage in an advertising "arms race". A firm's incentive to advertise is increasing in his competitor's level of advertising. Thus, in a Nash equilibrium the behavioral effect of a firm's advertising effort will partly be cancelled out by his competitor's advertising effort. Secondly, extensive advertising by a low quality producer, can undermine the effect of advertising. In particular, if advertising biases observations to the extent that it is no longer optimal to act in accordance with observations, then consumer would no longer be affected by advertising and firms would no longer have incentives to

[1] See e.g. "Vermont to Require Drug Makers To Disclose Payments to Doctors" by Melody Petersen, New York Times, June 13, 2002; and "Off the Charts: Pay, Profits and Spending in Drug Companies", a report by Families USA, July, 2001.

advertise.

The model of advertising as a distortion of social learning is similar to what social psychologists refer to as the social proof principle of advertising (See Cialdini 1993). In his well recognized book *Influence,* Cialdini (1993, p 116) writes: "Usually, when a lot of people are doing something, it is the right thing to do [...] it provides a convenient shortcut for determining how to behave but, at the same time, makes one who uses the shortcut vulnerable to the attacks of profiteers who lie in wait along its path." One of the attacks Cialdini refers to is the large number of non-informative television advertisements that make people familiar with a product by showing "ordinary" people using the product while constantly repeating the brand name.

So far economic theories of advertising have not captured the social proof principle[2]. Current theories do not explain how non-informative television advertisements simply showing a product being used by "ordinary" people affect people's behavior. Indeed, in the well known signaling models of advertising (see Nelson 1974, Kihlstrom and Riordan 1984, and Milgrom and Roberts 1986), the effect of advertising is entirely independent of the content of the advertisements. In these models, an advertisement by Coke may just as well give a favorable presentation of Pepsi, as long as the audience is convinced that Coke and not Pepsi pays the bill[3]. This is in contrast to the marketing literature in which it is taken as a given that the content of an advertisement and advertisement design affect product perceptions (see e.g. Moorthy and Hawkins, 2003). In the present model of advertising as a distortion of social learning, the effectiveness of an advertisement is crucially dependent on its content. An effective advertisement makes people familiar with the product being advertised. They may then later infer that this product must be of high quality.

In the following, we start out in section two by presenting a simple model of herding behavior. Section three introduces the phenomenon of availability heuristic. By combining a theory of herding

[2]See Bagwell (2003) for an excellent survey of economics of advertising.

[3]Note also that since advertising expenditures are not observable, burning money on advertising is a highly imperfect signal. It would be better to make the amount of "burned money" common knowledge by for example giving the money to a humanitarian organization.

behavior with the phenomenon of availability heuristic, section four shows how firms can influence people's choices by making them more familiar with their products through advertising. Section five analyzes the effect an advertising tax has on product quality. Finally, section six concludes the analysis and discusses some important policy implications.

2 A Simple Model of Herding Behavior

Two firms H and L are both introducing a new product to the market. The products of the two firms are similar, but they may differ in quality. Each firm $i \in \{H, L\}$ decides the quality of their product q_i. Firm L has higher marginal costs of increasing product quality than firm H. Let firm i's cost of increasing product quality be given by $c(q_i; i)$, where $c'(q_i; i)$ is unbounded[4], $c'(q; L) > c'(q; H)$ and $c''(q; i) > 0$ for all q. Clearly we expect firm H to be the high quality producer and firm L to be the low quality producer in equilibrium, and we will prove this below. Hence the notation H and L.

The firms sell their new product in two periods[5]. In each period, a large number of people purchase a product from either firm H or from firm L. There are no repeat purchases (i.e. the consumers in period one are different from those in period two). The consumers cannot observe product quality. It is well known from previous economic analysis that prices may serve as a perfect signal of product quality[6]. However, pooling equilibria or mixed equilibria, in which prices convey imperfect information about product quality, seem to be equally plausible[7]. We are interested in analyzing how advertising affects consumers' decision when prices do not perfectly signal quality. To simplify, we thus assume that prices carry no information about quality. Moreover, both firms

[4] This assumption is sufficient, but not necessary to ensure that the relevant strategy space is compact.

[5] The two period framework is chosen to keep the analysis simple. The propositions derived in this paper will also hold for a longer time horizon.

[6] See e.g. Klein and Leffler (1981), Chan and Leland (1982), Wolinsky (1983), Milgrom and Roberts (1986), and Bagwell and Riordan (1991).

[7] For pooling equilibria see Chan and Leland (1982). For mixed equilibria see Albrecht et al (2002).

are selling at the same exogenously given price p.

The timing is as follows: First, each firm decides its product quality. Then, consumers in period 1 decide which product to buy. Thereafter, consumers in period 2 observe the choice of one random individual among the consumers in period 1 and then decide which product to buy. Let this observation be denoted by $o \in \{H, L\}$.

A share λ of the consumers in each period are informed. These consumers receive information about which product is of the highest quality. A share $1 - \lambda$ of the consumers in each period are uninformed and do not receive any direct information about product quality. The uninformed consumers in period 2, however, can use their observation o to draw some inferences about the relative quality of the products.

Let $d = |q_H - q_L|$ denote the quality differential between the two products. Assume that the greater the quality differential between the two products, the larger the share of informed people. Thus, the share of informed people is a function of the quality differential, $\lambda(d)$, such that $\lambda(0) = 0$, $\lambda(d) \leq 1$ and $0 < \lambda'(d) < \infty$ for all d . This assumption reflects that the larger the quality differential, the easier it is to distinguish which of two products is of highest quality.

2.1 Consumer Decision

The consumers in each period have to decide whether to buy the product of firm H or of firm L. Let s_t denote the share of consumers buying the product of highest quality in period t. In the first period, the informed share of consumers, λ, buy the highest quality product, whereas the uninformed share of consumers, $1 - \lambda$, who have no way to distinguish between the two products, choose randomly. Thus,

$$\begin{aligned} s_1 &= \lambda + (1 - \lambda)\frac{1}{2} \\ &= \frac{1}{2}(1 + \lambda) \end{aligned} \tag{1}$$

In period 2, let $\hat{w}$ denote a person's belief that product o is of highest quality, i.e. if a person observes o, then he believes that product o is of highest quality with probability $\hat{w}$. Thus, if $\hat{w} > \frac{1}{2}$,

a person's optimal strategy is to mimic his observation o, while if $\hat{w} < \frac{1}{2}$, the optimal strategy is to choose the opposite product.

Assume that consumer know that some consumers are informed (i.e. $\lambda > 0$). Then, equation (1) implies that uninformed consumers in period 2 know that a share $s_1 > \frac{1}{2}$ choses the high quality product in period 1. Moreover, if the consumers' prior beliefs, that a firm i is of high quality, are $\Pr(i = H) = 0.5$ for both firms (uninformative priors), then Bayesian updating imply that[8] $\hat{w} = s_1$. Thus, since $s_1 > \frac{1}{2}$, an uninformed consumer in period 2 will always choose in accordance with his observation, o. Hence, in a large population

$$s_2 = \lambda + (1 - \lambda) s_1 \tag{2}$$

2.2 Firm Decision

Assume that there is a unit mass of consumers. Given the behavior of the consumers, the game between the firms is then defined by the payoff function

$$\pi_i = \begin{cases} p(s_1 + s_2) - c_i(q_i; i) & \text{if } q_i \geq q_{-i} \\ p(2 - s_1 - s_2) - c_i(q_i; i) & \text{if } q_i \leq q_{-i} \end{cases} \tag{3}$$

The firms have to decide what quality to produce. It follows from equations (1) - (3) that both firms' marginal benefit of increasing product quality is given by

$$\begin{aligned} MB &= p\lambda' \left[\left(\tfrac{\partial s_1}{\partial \lambda} + \tfrac{\partial s_2}{\partial \lambda} \right) + \tfrac{\partial s_2}{\partial s_1} \tfrac{\partial s_1}{\partial \lambda} \right] \\ &= p\lambda' \left[\left(1 - \tfrac{1}{2}\lambda \right) + \tfrac{1}{2} (1 - \lambda) \right] \end{aligned} \tag{4}$$

where $\lambda = \lambda(d)$ and $d = |q_H - q_L|$. The first term in (4) reflects a direct benefit of increasing product quality, whereas the second term reflects an indirect benefit of increasing product quality. For the high quality firm, the direct benefit is increased sales in both periods due to a larger share of informed people. The indirect benefit is increased sales in period 2 due to a larger share of the uninformed people learning (correctly) that this firm's product is the highest quality product. For the low quality producer, the direct benefit is increased sales in both periods due to a smaller share

[8] $\hat{w} = \Pr(i = H | o = i) = \frac{\Pr(o=i|i=H)\Pr(i=H)}{\Pr(o=i|i=H)\Pr(i=H) + \Pr(o=i|i=H)\Pr(i=H)} = \frac{0.5 s_1}{0.5 s_1 + 0.5(1-s_1)} = s_1$

of informed people. The indirect benefit is increased sales in period 2 due to a larger share of the uninformed people learning (incorrectly) that this firm's product is the highest quality product.

Equation (3) and (4) imply that the first order conditions for firm H and firm L's profit maximization problem are given by

$$p\left(\frac{3}{2}-\lambda\right)\lambda' = c'\left(q_H;H\right) = c'\left(q_L;L\right) \tag{5}$$

This condition implies, as expected, that firm H is the high quality producer.TThe second order conditions for both firms are fulfilled if

$$-c''\left(q_L;L\right) < p\left(\left(\frac{3}{2}-\lambda\right)\lambda'' - \left(\lambda'\right)^2\right) < c''\left(q_H;H\right) \tag{6}$$

Thus, we have the following lemma:

Lemma 1 *Assume that (6) holds. Then, there exists a Nash Equilibrium in which firm H produces quality q_H^* and firm L produces quality $q_L^* < q_H^*$, where q_H^* and q_L^* are determined by equation (5).*

3 Availability Heuristic

Tversky and Kahneman (1973) suggest that people infer the prevalence of an event "from the ease with which the event can be recalled or imagined." That is, if it is easier for a person to imagine H than to imagine L, then the person infers that H happens more frequently than L. This phenomenon, called availability heuristic, has been detected in several experimental studies (see Schwarz and Vaughn 2002). Moreover, Schrum (1999) argues that the availability heuristic can explain several empirical studies linking television watching to greater perceptions of the prevalence of violent crime, prostitution, alcoholism, drug abuse, divorce, heroic doctors, and private swimming pools. Schrum argues that frequent television watching increases the ease with which a person can imagine these types of events and thus makes him or her overestimate the prevalence of these events.

The availability heuristic suggests that people are not able to fully distinguish between different sources of information. Based on this theory, we will in the following assume that consumers are

unable to distinguish between observations of real people and fictitious characters in advertisements[9]. A person presented a choice between H and L may feel that H is more familiar than L. He is, however, not able to detect whether this is due to his exposure to advertisements. This is in line with important findings in cognitive psychology indicating clear functional differences between familiarity and recollection (see Kelley and Jacoby (2000) for a survey of this literature). When a person sees something that is familiar, the source of that familiarity is often ambiguous.

Note that the following is a model of imperfect information with fully rational agents. The analysis shows that even if a person knows that his observations of others may be distorted by observations of fictitious characters in advertisements and updates his beliefs accordingly, it is still rational for this person to choose the product that he has observed most often. In equilibrium this product is always most likely to be of the highest quality. Thus, advertising is distorting the social learning process described in Section 2, but it does not undermine this process.

4 Advertising as a Distortion of Social Learning

Assume now that firms can expose people to images of others using their product in advertisements. As in the herding model, a consumer in period 2 observes the product choice of one other person. Now, however, this person can either be a fictitious character in an advertisement or a real person from period 1. Let this observation be denoted by $o \in \{H, L\}$. Consumers are unable to distinguish between observations of real people and fictitious characters in advertisements but know this and update their beliefs accordingly.

Let z_i denote how much firm $i \in \{H, L\}$ spends on advertising. Consumers cannot observe firms' advertising expenditures. The likelihood of observing the product choice of somebody in an advertisement is dependent on how much the two firms spend on advertising. Assume that the

[9] Clearly a more realistic assumption would be that consumers have some ability, however imperfect, to distinguish between observations of real people and fictitious characters. Such an assumption would, however, further complicate our analysis without altering the results.

probability of observing somebody in an advertisement is

$$x = \eta \frac{z_H + z_L}{1 + z_H + z_L} \tag{7}$$

where $\eta \leq 1$. Note that this functional form reflects decreasing marginal returns to advertising. Moreover, there is a limit, η, to how much advertising consumers can absorb. If a person observes the product choice of somebody in an advertisement, then he observes firm i's product with probability $\frac{z_i}{z_H + z_L}$. Thus, the probability that an individual in period 2 observes firm i's product in an advertisement is

$$y_i = \eta \frac{z_i}{1 + z_H + z_L} \tag{8}$$

The timing is as follows: First, each firm i decides its product quality, q_i, and advertising expenditures, z_i. Then, consumers in period 1 decide which product to buy. Thereafter, consumers in period 2 will observe the product choice, o, of either a fictitious character in an advertisement or a real person from period 1. Finally, consumers in period 2 decide which product to buy.

4.1 Consumer Decision

The consumers in each period have to decide whether to consume the product of firm H or firm L. As in the situation with no advertising presented in Section 2, the share of consumers buying the product of highest quality in period 1, s_1, is given by

$$s_1 = \frac{1}{2}(1 + \lambda) \tag{9}$$

The probability that a person in period 2 observes H is then given by

$$w = y_H + (1 - x)\, s_1 \tag{10}$$

Again, let $\hat{w}$ denote a person's belief that product o is of highest quality, i.e if a person observes o, then he believes that product o is of highest quality with probability $\hat{w}$. Thus, if $\hat{w} > \frac{1}{2}$, a person's optimal strategy is to mimic his observation o, while if $\hat{w} < \frac{1}{2}$, the optimal strategy is to choose the opposite product.

Recall that consumers are unable to distinguish between real people and fictitious characters. Thus, uninformative priors and Bayesian updating imply, as in section 2.1, that $\hat{w} = w$. If consumers expectations are consistent with the firms' equilibrium strategy, we must have[10] $w \geq \frac{1}{2}$. To see this, assume that $w = \hat{w} < \frac{1}{2}$ in equilibrium. Then, consumers will not choose a product in accordance with their observation, and thus firms will not advertise. This leads to a contradiction, because if firms do not advertise, then we know from section 2 that $w = s_1 > \frac{1}{2}$. Since $w \geq \frac{1}{2}$ a consumer will always choose product in accordance with his observation. Thus, in a large population

$$s_2 = \lambda + (1 - \lambda) w \tag{11}$$

4.2 Firm Decision

The firms have to decide which quality to produce and how much to spend on advertising. Given the behavior of the consumers, the firms' profits are now given by

$$\pi_i = \begin{cases} p(s_1 + s_2) - c_i(q_i; i) - (1 + \tau) z_i & \text{if } q_i \geq q_{-i} \\ p(2 - s_1 - s_2) - c_i(q_i; i) - (1 + \tau) z_i & \text{if } q_i \leq q_{-i} \end{cases} \tag{12}$$

where τ is taxes on advertising. It follows from equation (9) - (12) that both firms' marginal benefit of increasing quality is given by

$$MB_{q_i} = p \left(\left(\frac{3}{2} - y_H - \frac{1}{2} (1 - x) (1 + \lambda) \right) \lambda' + \frac{1}{2} (1 - \lambda) (1 - x) \lambda' \right) \tag{13}$$

where $\lambda = \lambda(d)$ and $d = |q_H - q_L|$. Firms still face a direct benefit and an indirect benefit of increasing quality of production. By comparing equation (13) to equation (4) we can, however, see that firms' possibilities to advertise decrease the indirect benefit of increasing product quality. This is because a smaller share of the uninformed people in period 2 are now learning by observing real people from period 1. Equations (12) and (13) imply that the first order conditions for firm H and firm L's profit maximization problems with respect to product quality are given by

$$p \left(\frac{3}{2} - \lambda - y_H + x\lambda \right) \lambda' = c'(q_H; H) = c'(q_L; L) \tag{14}$$

[10] Below we demonstrate that the condition $w \geq \frac{1}{2}$ is satisfied in the proposed equilibrium.

Equations (7) - (12) imply that the firms' marginal benefit of increasing advertising are respectively given by

$$\begin{aligned} MB_{Z_H} &= \eta p\,(1-\lambda)\,\tfrac{z_L+\frac{1}{2}(1-\lambda)}{(1+z_H+z_L)^2} \\ MB_{Z_L} &= \eta p\,(1-\lambda)\,\tfrac{z_H+\frac{1}{2}(1+\lambda)}{(1+z_H+z_L)^2} \end{aligned} \tag{15}$$

Note that since the marginal cost of advertising is $1+\tau$, optimal advertising is zero if $MB < 1+\tau$ for $z_i = 0$. Henceforth, we will focus on the interior solution. Thus, the first order conditions for firm H and firm L's profit maximization problems with respect to advertising imply that

$$\begin{aligned} z_H &= \tfrac{1}{4}\tfrac{p\eta}{1+\tau} - \tfrac{1}{2} - \left[\tfrac{1}{4}\tfrac{p\eta}{1+\tau} + \tfrac{1}{2}\right]\lambda \\ z_L &= \tfrac{1}{4}\tfrac{p\eta}{1+\tau} - \tfrac{1}{2} - \left[\tfrac{1}{4}\tfrac{p\eta}{1+\tau} - \tfrac{1}{2}\right]\lambda \end{aligned} \tag{16}$$

The equations in (16) imply that in equilibrium we must have $z_L > z_H$ (i.e. the low quality producer spends more on advertising than the high quality producer). Note that an interior solution (i.e. $z_H,\, z_L > 0$) gives the following parameter restriction

$$p > \frac{2\,(1+\lambda)\,(1+\tau)}{\eta\,(1-\lambda)} \tag{17}$$

Equations (7) - (10) and (16) imply

$$w = \frac{1}{2}\lambda\,(1-\eta) + \frac{1}{2} \geq \frac{1}{2} \tag{18}$$

Thus, consumers' beliefs are correct. The second order conditions for both firms are fulfilled if

$$-c''\,(q_L; L) < p\left(\left(\frac{3}{2} - \lambda - y_H + x\lambda\right)\lambda'' - \left(\lambda'\right)^2(1-x)\right) < c''\,(q_H; H) \tag{19}$$

Hence, we have the following proposition:

Proposition 2 *Assume that (19) holds and that* $p > \frac{2(1+\lambda)(1+\tau)}{\eta(1-\lambda)}$. *Then, there exists a Nash Equilibrium in which firm H produces quality* q_H^* *and firm L produces quality* $q_L^* < q_H^*$. *Moreover, firm H spends* z_H^* *on advertising, and firm L spends* $z_L^* > z_H^* > 0$ *on advertising. The levels of advertising,* z_L^* *and* z_H^*, *and product quality,* q_H^* *and* q_L^*, *are determined by (14) and (16).*

Existence of the equilibrium of Proposition 2 follows from the fact that (14) and (16) define continuous best response functions, and that our assumptions ensures that the optimal solution $(q_H^*, q_L^*, z_H^*, z_L^*)$ must be contained in a compact set.

The requirement for an inner solution, (17), implies that

$$\frac{1}{4}\frac{p\eta}{1+\tau} > \frac{1}{2}\frac{(1+\lambda)}{(1-\lambda)} > \frac{1}{2} \tag{20}$$

Recall that λ is strictly increasing in the quality differential between the two products[11]. Thus, equations (16) and (20) imply that the smaller the quality differential between the two products, the larger each firm's advertising expenditure (z_H and z_L). This result should not be surprising. It follows from the fact that the smaller the quality differential, the larger the share of uninformed consumers who can be affected by advertising.

Note that a consumer is aware that his observation may be of a fictitious character in an advertisement or of a real person. It is, however, still rational for the consumer to act in accordance with his observation, because the product he observes (i.e. the product which is easiest to imagine) is most likely to be of the highest quality. This is because if advertising biased observations to the extent that it would no longer be optimal to act in accordance with observations, then firms would no longer have incentives to advertise.

Also note that in equilibrium, the low quality producer spends more on advertising than the high quality producer. This is because the low quality producer has the lowest market share in period 1. Thus, an uninformed person in period 2, who observes a real person from period 1, is more likely to observe product H than L. Hence, firm L has a stronger incentive to advertise. This is similar to Bisin and Verdier (2002) in which parents invest more in educating their children if few people in society behave in the way the parents want their children to behave.

The negative relationship between a firm's advertising and product quality is in line with empirical investigations. Studies of the optometry industry by Kwoka (1984) find a negative correlation between the quality of eye examination[12] offered by a firm, and the extent to which the firm is advertising. These results are later backed by Parker (1995). Moreover, Horstman and Moorthy (2003) show that in New York, high quality restaurants advertise less than medium

[11] The greater the difference in the firms' marginal costs of increasing product quality, the larger the quality differential between the two products (see equation (14)).

[12] Where quality is measured as time spent in the examination.

quality restaurants.

There are also several empirical studies suggesting a positive relationship between a firms' quality and advertising. These empirical studies are, however, associated with advertising that contains direct information as to product quality (Bagwell 2003). Based upon these studies, Bagwell (2003) argues that the positive relationship seems to reflect the differential benefit that firms with high quality products enjoy from providing direct product-quality information through their advertisements. Clearly, this type of direct quality-information advertising is different from the non-informative type of advertising analyzed in the present paper.

It is worth noting that the negative relationship between a firm's advertising and product quality does run contrary to the implication of the signaling model of Milgrom and Robert (1986), where advertising expenditure is a signal of product quality. Their model extends Nelson's (1974) argument that high quality producers have the strongest incentive to achieve an initial sale through advertising due to repeat purchases. Note that in our model there is no repeat purchases. Hence, our result does not directly contradict Milgrom and Roberts claim, rather we consider a different class of products.

5 Advertising and Product Quality

In this section we will investigate the effect of a tax on advertising on product quality. We will see that if the majority of the people in society are informed, then a tax on advertising will decrease both firms' product quality. However, if the majority of the people in society are uninformed, then a tax on advertising will increase the product quality of both firms.

Equations (7), (8) and (16) imply that in equilibrium

$$y_H = \frac{1}{2}\frac{\frac{p\eta}{1+\tau}(1-\lambda)-2(1+\lambda)}{p(1-\lambda)} \tag{21}$$

$$x = \frac{\frac{p\eta}{1+\tau}(1-\lambda)-2}{p(1-\lambda)} \tag{22}$$

Substituting for y_H and x in equation (13) yields

$$MB_{q_i} = \frac{1}{2}\lambda' \left(2 - 2p\lambda + 3p + (2\lambda - 1)\frac{p\eta}{1+\tau}\right)$$

Differentiation with respect to τ implies

$$\frac{\partial MB_{q_i}}{\partial \tau} = -\frac{1}{2}\frac{p\eta}{(1+\tau)^2}\lambda'(2\lambda - 1)$$

Thus, we have the following proposition:

Proposition 3 *If the majority of the people in society are informed, then an increase in tax on advertising will decrease both firms' product quality. If the majority of the people in society are uninformed, then an increase in tax on advertising will increase both firms' product quality*

Recall that both firms are facing both a direct benefit and an indirect benefit of increasing product quality. For firm H, the direct benefit is increased sales due to a larger share of informed people, and the indirect benefit is increased sales due to a larger share of the uninformed people learning (correctly) that H is the highest quality product. A tax increase will reduce both firms' advertising expenditures, and thus decrease the extent to which advertising distorts social learning. This implies that a tax increase will reduce firm H's direct benefit, whereas it will increase firm H's indirect benefit of increasing product quality. The direct benefit decreases because, as social learning is less distorted, uninformed people are more likely to choose the high quality product. This makes it less important for firm H to increase the share of informed consumers. The indirect benefit increases because, as social learning is less distorted, the share of high quality consumers in period 1 has a stronger effect on the share of uninformed consumers in period 2 choosing the high quality product. This makes it more important for firm H to increase the share of informed consumers.

For firm L, the direct benefit of increasing product quality is increased sales due to a larger share of uninformed people, and the indirect benefit is increased sales due to a larger share of the uninformed people learning (incorrectly) that L is the highest quality product. Similar to firm H,

a tax increase will decrease the direct benefit, whereas it will decrease the indirect benefit. For both firms H and L, when the majority of consumers are informed, the decrease in the direct benefit dominates the increase in the indirect benefit. Hence, when the majority of the consumers are informed, a tax increase will decrease the product quality of both firms. This is because advertising reinforces firms' competition on product quality.

6 Conclusion: Public Policy

Legislators have long been concerned about regulating advertising. For example, prior to 1977, most states barred optometrists from advertising (Parker, 1995). More recently, rapidly increasing promotion expenditures on prescription drugs have caught the attention of legislators[13]. In 2000 drug companies spent $4 billion on detailing (i.e. representatives from the pharmaceuticals promoting the drug by personally visiting or calling physicians) and $2.5 billion on direct-to-consumer advertising[14]. Legislators and consumer interest groups are worried that this extensive promotion of prescription drugs can bias physicians' decisions. Moreover, they are worried that the enormous expenditures on promotions will decrease pharmaceutical investments in research and development that can improve product quality.

In order to evaluate the impact of legislators' effort to regulate advertising it is important to understand how advertising affect peoples' choices. In this paper we develop a new theory of advertising. On the background of the phenomena of herding behavior and availability heuristic we present a model in which people learn about product quality by observing the choices of others, but are not able to fully distinguish between observations of real people and fictitious characters in advertisements. People are, however, fully aware of this limitation, and update their beliefs

[13] See e.g. "Vermont to Require Drug Makers To Disclose Payments to Doctors" by Melody Petersen, New York Times, June 13, 2002; and "Off the Charts: Pay, Profits and Spending in Drug Companies", a report by Families USA, July, 2001.

[14] Source: "Prescription Drugs and Mass Media Advertising", a report by the NIHCM foundation, November, 2001.

accordingly. The analysis shows that even if a person knows that his observations of others may be distorted by observations of fictitious characters in advertisements, it is still rational for this person to choose the product that he has observed most often.

Our model of advertising as a distortion of social learning suggests that legislators should be less concerned about advertising biasing consumers decision. Interestingly, the model suggests that the degree to which advertising bias consumers' decisions is limited for two reasons: Firstly, firms engage in an advertising "arms race". A firm's incentive to advertise is increasing in his competitor's level of advertising. Thus, in a Nash equilibrium the behavioral effect of a firm's advertising effort will partly be cancelled out by his competitor's advertising effort. Secondly, extensive advertising by a low quality producer, can undermine the effect of advertising. In particular, if advertising biases observations to the extent that it is no longer optimal to act in accordance with observations, then consumer would no longer be affected by advertising and firms would no longer have incentives to advertise.

Importantly, our model also suggest that regulating advertising can have unintended effects on product quality. The effect of advertising depends on how well informed consumers are about product quality. Indeed, in markers where most consumers are well informed about product quality, regulating advertising will decrease firms' investments in product quality. This is because advertising is intensifying firms' competition on product quality.

References

[1] Albrecht, J., H. Lang and S. Vromanand, 2002, "The Effect of Increasing Information on the Well-Being of the Uninformed: What's the Chance of Getting a Decent Meal in an Unfamiliar City?" *International Journal of Industrial Organization*, 20 (2), 139-162.

[2] Anderson, L.R. and C.A. Holt, 1997, "Information Cascades in the Laboratory", *American Economic Review*, 87, 847-862.

[3] Bagwell, K., 2003, "The Economic Analysis of Advertising", *Working Paper*, Columbia University.

[4] Bagwell, K. and M.H. Riordan, 1991, "High and Declining Prices Signal Product Quality", *American Economic Review*, 81, 224-239.

[5] Banerjee, A.V., 1992, "A simple model of herd behavior", *The Quarterly Journal of Economics*, 107(3), 797-817.

[6] Bikhchandani, S., D. Hirshleifer, and I. Welch, 1992, "A Theory of Fads, Fashion, Custom and Cultural Change as Informational Cascades", *Journal of Political Economy*, 100(5), 992-1026.

[7] Bikhchandani, S., D. Hirshleifer, and I. Welch, 1998, "Learning from the Behavior of Others: Conformity, Fads and Informational Cascades", *Journal of Economic Perspectives*, 12(3), 151-170.

[8] Bisin, A. and T. Verdier, 2002, "The Economics of Cultural Transmission and the Evolution of Preferences", *Journal of Economic Theory*, 97(1), 298-319.

[9] Chan, Y.S. and H. Leland, 1982, "Prices and Qualities in Markets with Costly Information", *Review of Economic Studies*, XLIX, 499-516.

[10] Cialdini, R.B., 1993, *Influence*, New York: Quill.

[11] Horstman, I.J., and S. Moorthy, 2003, "Advertising Spending and Quality for Services: The Role of Capacity", *Quantitative Marketing and Economics*, forthcoming.

[12] Kelley, C.M., and L.L. Jacoby, 2000, "Recollection and Familiarity: Process-Dissociation", in *The Oxford Handbook of Memory*, E. Tulving and F.I.M. Craik (eds.), Oxford University Press.

[13] Kihlstrom, R.E. and M. H. Riordan, 1984, "Advertising as a Signal", *Journal of Political Economy*, 92(3), 427-450.

[14] Klein, B. and K.B. Leffler,1981, "The Role of Market Forces in Assuring Contractual Performance", *Journal of Political Economy,* 89, 615-641.

[15] Kwoka, J.E., 1984, "Advertising and the Price and Quality of Optometric Services", *American Economic Review*, 74(1), 847-862.

[16] Milgrom, P. and J. Roberts, 1986, "Price and Advertising Signals of Product Quality", *Journal of Political Economy*, 94(4), 796-821.

[17] Moorthy, S., and S. Hawkins, 2003, "Advertising Repetition and Quality Perceptions", *Journal of Business Research*, forthcoming.

[18] Nelson, P., 1974, "Advertising as Information", *Journal of Political Economy*, 82(4), p. 729-754.

[19] Parker, P.M., 1995, "Sweet Lemons: Illusory Quality, Self Deceivers, Advertising, and Price", *Journal of Marketing Research*, 32(3), 291-307.

[20] Samuelson, L., 2003, "Information-Based Relative Consumption Effects", *Econometrica*, forthcoming.

[21] Schrum, L.J., 1999, "Television and Persuasion: Effects of the Programs between the Ads", *Psychology and Marketing*, 16(2), 119-140.

[22] Schwartz, N and L.A. Vaughn, 2002, "The Availability Heuristic Revisited: Ease of Recall and Content of Recall as Distinct Sources of Information", in *Heuristics and Biases* by Gilovich T., G. Dale and D. Kahnemann (eds.), Cambridge: Cambridge University Press.

[23] Tversky A. and D. Kahneman, 1973, "Availability: A Heuristic for Judging Frequencey and Probability", *Cognitive Psychology*, 5, 207-232.

[24] Wolinsky, A., 1983, "Prices as Signal of Product Quality, Review of Economic Studies", *Review of Economic Studies*, 647-658.