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# DISSIPATIVE ADVERTISING IN RETAIL MARKETS

**Abstract.** *Significant amounts of money are spent every year on advertising. Because under some legislation the direct advertising of the products' price is forbidden and the quality is very difficult to be signaled, it is important to know if the dissipative advertising maybe successfully used by the firms to signal elements as the price or the quality of the goods. Dissipative advertising has two main characteristics: first it does not directly affect demand and second it is easy to observe that a substantial amount of money has been spent.*

*In this paper we analysed the advertising behaviour of firms with private information as to their respective qualities. The key point is that the firm which spends the most on advertising has the highest quality. Thus the "non-informative" advertising is able to signalize to consumers the highest quality firm.*

**Keyword:** *advertising, dissipative advertising, quality, equilibrium, search rule.*

**JEL Classification: L11, L22**

## 1. Introduction

Significant amounts of money are spent every year on advertising. For example if we speak only about the advertising through mobile phones, in 2011 the amounts spent in the U.S. passed the $1 billion. More exactly, the $1.23 billion spent in 2011 is nearly double the investment made by advertisers into mobile ads in the U.S. in 2010 (which was $743 million) but it represents only 28% of predictions for 2015.

According to the classic view of advertising, advertising is persuasive – that is, by modifying tastes and creating brand loyalty, advertising changes the preferences of consumers.

Since consumers' willingness to pay for the goods increases, the demand for the sponsoring brand increases as well and becomes less elastic.

The interpretation of advertising as persuasive has been criticized because it assumes that demand is positively affected by advertising, while consumers' utility is not. In the case of advertising as a complement this problem is solved since it is assumed that consumers hold a stable set of preferences into which advertising enters as one argument.

As it is well known, the main important aspects which are taken into consideration by a buyer when she choose a product, besides the satisfaction of a need, are the price and the quality. However, under some legislation the direct advertising of the products' price is forbidden and beside this the quality is very difficult to be signaled since usually the consumer has to buy and use the product in order to observe it's quality. Because of these the economists tried to see if the use of high prices will induce the consumers the impression of a high quality of the good. An impediment here is that a low quality producer may mimes the presence of a high quality if there is no other element which can help the consumers to distinguish between the two groups of producers. Such an element seems to be the amount spent by the firms on advertising, the so called "dissipative advertising", which can show the financial power of the firm and by this, the efforts invested by the firm in research and development.

Dissipative advertising has two main characteristics: first it does not directly affect de mand (not persuasive nor informative content) and second it is easy to observe that a substantial amount of money has been spent.

At this point another questions arrives in mind: is the dissipative advertising a sufficient element for revealing the quality of the goods? under which set of conditions the dissipative advertising helps consumers to infer the quality of the goods? have a high quality producer to rely on dissipative advertising for signaling the quality of it's goods?

## 2. Literature review

The term dissipative advertising indicates that it is just the cost of the ad, instead of its content, which is able to transmit information to consumers. The firm burns money in the advertising campaign and this is publicly observable; the consequence is that advertising expenses can indirectly communicate information to consumers (Nelson (1974)). Under such indirectly informative advertising, the sponsoring firm does not necessarily give truthful information. By the amount of the advertising expenditure the firm may be able to convince consumers that its claims are truthful.

In the economics literature it has been well established theoretically that advertising spending can be a signal of product quality for experience goods Nelson (1974), Varian (1980), Kihlstrom and Riordan (1984) and Milgrom and Roberts (1986).

Starting with Lucas (1972), many economists have embraced the idea that dispersed information is a powerful tool for explaining some macroeconomic puzzles, for instance the existence of nominal rigidities and real effects of money.

In Bagwell and Lee (2010) the authors construct an advertising equilibrium in which informed consumers use an advertising search rule and buy from the highest-advertising firm. They modify the Bagwell and Ramey (1994) model by assuming that each firm has private information about its exogenous costs of production but is made no assumption on the quality of the goods and its importance when consumers select what firm to visit in order to buy the good.

By this point of view we can say that the relation between the quality and unit cost in Bagwell and Lee (2010) may be represented as follows:

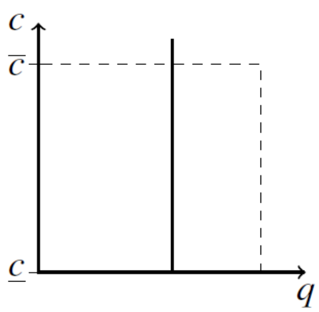


**Figure 1. Relation between the quality and unit cost**

Athey et al. (2004) establish related conditions under which optimal collusion for sellers in a first-price procurement auction entails pooling at the buyer's reservation value. Building on techniques used by Athey et al. (2004), Bagwell and Lee show that the random equilibrium's advantage overwhelms its disadvantage, if the distribution of types is log-concave and demand is sufficiently inelastic.

Another important paper for the economics of advertising is Linnemer (2011), where the author extends the classical quality signaling model Milgrom and Roberts (1986) by allowing the quality to vary continuously. Taking into account the good's quality as in Linnemer (2011) can be a interesting extension of the paper of Bagwell and Lee (2010). Another extension for Bagwell and Lee (2010) is made by Bagwell and Lee (2012) which analyze the implications of variation of firms' number upon the equilibriums of the model.

### 3. The Model

We assume that N ≥ 2 ex ante identical firms compete for sales in a homogenous good market. Each firm is privately informed of its unit cost level $c_i$.

The costs are iid and are drawn from the support $[\underline{c},\bar{c}]$. As in Linnemer (2011) we allow the quality of the good (noted with q) to vary continuously.

**Assumption 1.** *The production unit cost is an increasing function of the good's quality: c'(q)>0.*

This assumption is a realistic one as it is well known that for increasing the quality of

a good, the producing firm has to buy new technologies or to hire specialized personnel. If in the case of employment it is obviously that the unit cost increases, in the case of new producing technologies we may also have the case of a decreasing unit cost if for example it allows the firm to reduce the technological consumption.

For the ease of exposure we will take a linear function of cost: $c(q) = aq$, where $\alpha \in (0,1]$. This relation can be graphically represented as follows:

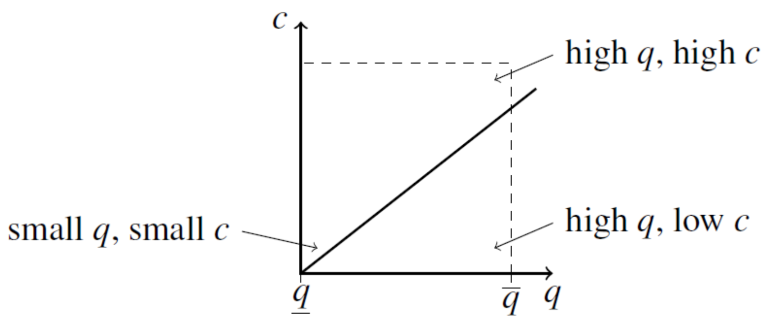


**Figure 2. Relation between the unit cost and quantity produced**

**Assumption 2.** *The quality levels are iid across firms and the quality type q is drawn from the support* $[\underline{q}, \bar{q}]$ *according to the distribution function F(q) of class $C^2$, where* $\underline{q} > \bar{q} > 0$. *The density* $f(q) \equiv F'(q)$ *is positive on* $[\underline{q}, \bar{q}]$.

Within this model is assumed that the consumers are interested in buying from the firm with the highest quality type. This assumption is not a very unrealistic one. For example, if we think about drugs then the price difference between the generic drugs of the same drug is generally higher than the quality difference of these generic drugs. This is quite normally as by definition the generic drugs may be produced after the expiration of a patent (the expiration removes the monopoly of the patent holder on drug sales licensing) and comparable to patented drug in dosage form, strength, route of administration, quality and performance characteristics.

**Assumption 3.** *The firms face a unit mass of consumers, where each consumer has a demand function of class* $C^2$ *which satisfies the relations D(p) > 0 > D'(p) .*

Following extant literature (Moorthy (1988); Tirole (1988); Mas-Collel et al. (1995)), we

assume a quasilinear form for the individual utility $U = \theta q - p$, where the parameter θ is a random variable defined on the interval [0,1] which represents the consumer's marginal willingness to pay for quality. For the ease of computations we will consider that the cumulative distribution G of q is the uniform distribution. In this case the demand function is given by $D(x) = 1 - G(x) = 1 - \frac{p}{q}$. As D(x) has to be positive we have to have the relation $p \leq q$.

With respect to the consumers behaviour, as in Bagwell and Lee (2010) we consider that there are two types of consumers: informed (they observe firms' advertising expenses) and uninformed consumers. The informed consumers may use an advertising search rule as for example they visit the firm that advertise the most. The uninformed consumers use a random search rule which means that they choose randomly which firm to visit (as we said, we try to verify the validity of the theory according to which the advertising may be used as a signal fo the quality). As we have a unit mass of consumers, the firm which advertise the most will sell its good to $M(q) = \frac{U}{N} + IF(q)^{N-1}$ consumers (M can be interpreted as the market share of the firm).

Further, we will note with $r(p,q)$ the net revenue of a monopolist firm (it does not take into account the advertising expenses and assume a market share of 100%) and with $\pi(p,q)$ the firm's profit after the deduction of the advertising expenses. Therefore we have:

$$r(p,q) = (p-\alpha q)\left(1-\frac{p}{q}\right)$$

$$\pi(p,q) = r(p,q)M - A(q)$$

$$= (p-\alpha q)\left(1-\frac{p}{q}\right)\left(\frac{U}{N} + IF(q)^{N-1}\right) - A(q)$$

**Assumption 4.** *Between p and q is the following relation*$:\$ p \geq \sqrt{\alpha} q$

Analyzing the above relations, it is easy to observe that $r(p,q)$ is strictly concave in $p$ with a unique maximizer $p^m = \frac{1+\alpha}{2}q.$ Also, as $p \geq \sqrt{\alpha}q,$ we obtain that $r(p,q)$ is strictly increasing in q.

In order to be able to obtain a separating equilibrium we have to see which is the best level of quality for a firm's profit and for a consumer's surplus. The Appendix A.2 and A.3 contain a proof of the fact that both the firm's profit and the consumer's surplus are increasing functions of $q$.

## 4. The advertising equilibrium

In an advertising equilibrium is assumed that the informed consumers select what firm to visit on the basis of the advertising search rule while the uninformed consumers select randomly what firm to visit.

**Proposition 1.** *There is a unique advertising equilibrium where A(q) is strictly decreasing and differentiable. Likewise we have* $A(\underline{q}) = 0.$

**Proof.** First of all we try to find the properties of an advertising equilibrium. For any $q \in [\underline{q}, \overline{q}]$ and any $\hat{q} \in [\underline{q}, \overline{q}]$, the are the following incentive constraints:

$$r(p,q)M(q) - A(q) \geq r(p,q)M(\hat{q}) - A(\hat{q})$$

$$r(p,\hat{q})M(\hat{q}) - A(\hat{q}) \geq r(p,\hat{q})M(q) - A(q)$$

Adding these relations we have $[r(p,q)-r(p,\hat{q})][M(q)-M(\hat{q})] \geq 0.$ Since $r(p,q)$ is strictly increasing in $q$, it means that $M(q)$ has to be nondecreasing. Thus it is necessary to have $M(q)=\frac{U}{N}+IF(q)^{N-1}$, meaning that $M(\underline{q})=\frac{U}{N}$. From the incentive constraints we obtain that $A(q)$ is nondecreasing. Therefore a firm of type $\underline{q}$ cannot be deterred from selecting no advertising and we also obtain that $A(\underline{q})$ has to be equal to zero.

In order to not lose from sight a non-interior solution we adopt the same methodology as in Bagwel and Lee (2010) for finding the expression of $\mathrm{A}(\mathrm{q})$. We obtain that:

$$A'(q)=r(p,q)\frac{\partial M(q)}{\partial q}$$

From this differential equation and the binding constraint $A(\underline{q})=0$ we have:

$$A(q)=\int_{\underline{q}}^{q} r(p,z)\frac{\partial M(z)}{\partial z}\,dz$$

After the integration by parts we find that $A(q)$ has the following form:

$$A(q)=r(p,q)M(q)-r(p,\underline{q})M(\underline{q})-\int_{\underline{q}}^{q}\left(\frac{p^2}{z^2}-\alpha\right)\left[\frac{U}{N}+IF(z)^{N-1}\right]dz \qquad (1)$$

Using the fact that $A(\overline{q})=0$, we obtain the following expression for the firm's profit:

$$\begin{aligned}\Pi(p,q;A) &= r(p,\underline{q})M(\underline{q})+\int_{\underline{q}}^{q}\left(\frac{p^2}{z^2}-\alpha\right)\left[\frac{U}{N}+IF(z)^{N-1}\right]dz\\ &= r(p,\underline{q})\frac{U}{N}+\int_{\underline{q}}^{q}\left(\frac{p^2}{z^2}-\alpha\right)\left[\frac{U}{N}+IF(z)^{N-1}\right]dz \qquad (2)\end{aligned}$$

From the above relation is obviously that $\Pi(p,q;A)>0$ for all $q\in[\underline{q},\overline{q}]$.

In the case of advertising equilibrium we may write the expected market share of a firm of type $q$ as: $M = \frac{U}{N} + IF(q)^{N-1}$. This way we observe that any firm is sure to get its share of uninformed consumers and it will win the informed consumers with the probability $F(q)^{N-1}$ (the probability that the others $N-1$ firms draw smaller types). Integrating by parts equation (2) we find the next expression for the expected profit of a firm in the advertising equilibrium:

$$E_q[\Pi(p,q;A)] = r(p,\underline{q})\frac{U}{N} + E_q\left[\frac{1-F}{f}(q)\left(\frac{p^2}{q^2}-\alpha\right)\left(\frac{U}{N}+IF(q)^{N-1}\right)\right] \quad (3)$$

The first on the RHS represent the "profit at the bottom" or other words the profit made by the firm with a quality level equal to The second term on the RHS represents the expected rent of information. It is not very clear if a strictly increasing market share allocation amplify the value of this term. We observe that the term $\left(\frac{p^2}{q^2}-\alpha\right)$. As we know for many popular distributions the cumulative distribution function $F$ is log-concave which imply that the term $\frac{1-F}{f}(q)$ is decreasing in q. Because $M(q)$ is increasing in $q$ it means that allocating more market share to the higher type (the firm with the highest quality but in the same time with the highest unit cost) works against the direction implied by the log-concavity of F.

### 5. The Random Equilibrium

In a random equilibrium is assumed that the consumers select what firm to visit on the basis of a random search rule. Therefore at the equilibrium the firms spend no money on advertising as the advertising brings no benefit to firms, because even the informed consumers will select randomly what firm to visit.

The profit made by a firm in this equilibrium is $\Pi(p,q;A) = r(p,q)\frac{1}{N}$. Therefore it is straightforward to find the expression for the expected profit of a firm in the random equilibrium:

$$E_q[\Pi(p,q;A)] = r(p,\overline{q})\frac{1}{N} - E_q\left[\frac{F}{f}(q)\frac{1}{N}\left(\frac{p^2}{q^2}-\alpha\right)\right] \quad (4)$$

The first on the RHS represent the "profit at the top" or other words the profit made by the firm with a quality level equal to $\overline{q}$. If the cumulative distribution function $F$ is log-concave then the term $\frac{F}{f}(q)$ is nondecreasing in $q$.

We have to observe that the market share allocated to the "profit at the top" in the case of the random equilibrium is greater than the market share allocated to the "profit at the bottom" in the case of the advertising equilibrium.

## 6. Comparison of the Advertising and Random Equilibria

The comparison of the two equilibria is a not at all an easy task. This is because we have two expressions with a total of four different terms. Schematically we can write:

- for the advertising equilibrium: $E_q[\Pi(p,q;A)] = r(p,\underline{q})\frac{U}{N} + \beta_1$
- for the advertising equilibrium: $E_q[\Pi(p,q;A)] = r(p,\overline{q})\frac{1}{N} - \beta_2$

In the above relations we have the following inequalities:

- $r(p,\underline{q}) < r(p,\overline{q})$
- $\frac{U}{N} < \frac{1}{N}$
- $\beta_1 > 0$ and $\beta_2 > 0$

For the special case where the support of possible quality types is small we can make a clear distinction between the expected profits of the two equilibria. As the difference $\overline{q} - \underline{q}$ tends to zero, the profit in the case of advertising equilibrium tends to $r(p,\underline{q})\frac{U}{N}$ and the profit in the case of random equilibrium tends to $r(p,\overline{q})\frac{1}{N}$. Thus it is obviously that in this situation the expected profit is higher in the random equilibrium.

The consumers are able to obtain a positive surplus regardless of what equilibrium we speak. The Appendix A.4 contains a proof of this affirmation.

Intuitively, the uninformed consumers perform identically in the two equilibria as they use a random search rule in both situations. On the other hand, the informed consumers prefer the advertising equilibria as they may observe the advertising expenses and are able to infer the quality of the goods on basis of these amounts.

### 7. Conclusion

In this paper we analysed the advertising behaviour of firms with private information as to their respective qualities. Because of the relation assumed between the unit cost and the quality of a good it results that the unit costs also represent a private information. The key point is that the firm which spend the most on advertising has the highest quality. Thus the "non-informative" advertising is able to signalize to consumers the highest quality firm. However, due to the relation between unit cost and quality, the firm with the highest quality has also the highest unit cost.

For the analysis of the firm's profit we have to take also into account the shape of the demand function and as we proof in the paper, under specific circumstances it is possible that the firm with the highest unit cost to obtain a greater profit (due to the quality of its good, the faster increase of the demand comparatively with the decrease of the unit profit etc.).

In order to be able to obtain a situation where the dissipative advertising helps consumers to infer the quality of the goods we imposed some restrictions on the price level of the goods. These restrictions are also due the relation imposed between the unit cost and the quality and the specific form assumed for the cumulative distribution function of the quality types. However these restrictions of the model were necessary to simplify the computations. Therefore a further extension of this paper will be to relax these restrictions.

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## Appendix 1

### The Monopol Price

For the monopolist case there is no need to distinguish between informed and uninformed consumers as they have only one option for which firm to visit. Thus it also clear that the monopolist has no intention to advertise. Therefore the profit of the firm may be written as:

$$\pi(p,q) = (p-\alpha q)(1-\frac{p}{q})$$

The price which maximize the firm's profit is:

$$p^m = \frac{1+\alpha}{2}q$$

**Appendix 2**

**The Monopoly Profit's Dependence on $q$**

Now we try to find how vary the maximum profit when $q$ varies:

$$\frac{d\pi^m}{dq} = \left.\frac{\partial\pi}{\partial q}\right|_{p=p^m} = \left.\left[-\alpha\left(1-\frac{p}{q}\right)+\frac{p}{q^2}\left(p-\alpha q\right)\right]\right|_{p=p^m}$$

$$= \frac{(1-\alpha)^2}{4} > 0$$

**Appendix 3**

**The Dependence on $q$ of the Consumer's Surplus in Case of the Monopoly**

The Monopoly Profit's Dependence on $q$.

We have the following relations between $p$ and q: $\sqrt{\alpha}q \le p \le q$

Because $\alpha \in (0,1]$, we get that $0 < \alpha^2 \le \alpha \le \sqrt{\alpha} \le \frac{1+\alpha}{2} \le 1.$

The consumer's surplus obtained when the price is equal to $p^m$ is given by:

$$S^m = \int_{p^m}^{q}\left(1-\frac{z}{q}\right)dz$$

As in the ace of the maximum profit, we try to find how the consumer's surplus attained for price $p^m$ depend on the variation of q:

$$\frac{dS^m}{dq} = \left.\frac{\partial S}{\partial q}\right|_{p=p^m} =' \left.\left[\int_{\frac{1+\alpha}{2}q}^{q}\frac{z}{q^2}dz+\left(1-\frac{q}{q}\right)q'-\left(1-\frac{\frac{1+\alpha}{2}q}{q}\right)\left(\frac{1+\alpha}{2}q\right)\right]\right|_{p=p^m}$$

$$= \frac{(1-\alpha)^2}{8} \ge 0$$

**Appendix 4**
**Positive Consumer's Surplus**

$$S = \int_p^q \left(1 - \frac{z}{q}\right) dz$$

$$= \left(z - \frac{z^2}{2q}\right)\Bigg|_p^q = \frac{(q-p)^2}{2q} > 0$$

**Appendix 5**
**The Expected Profit under the Random Equilibrium**

The profit made by a firm in this equilibrium is $\Pi(p,q;A) = r(p,q)\frac{1}{N}$.

Applying the expectation operator we get:

$$E_q[\Pi(p,q;A)] = \int_{\underline{q}}^{\bar{q}} \left[ r(p,\bar{q})\frac{1}{N} f(q) \right] dq$$

$$= \left[ r(p,\bar{q})\frac{1}{N} F(q) \right]\Bigg|_{\underline{q}}^{\bar{q}} - \int_{\underline{q}}^{\bar{q}} \left[ \frac{\partial r(p,\bar{q})}{\partial q}\frac{1}{N} F(q) \right] dq$$

$$= r(p,\bar{q})\frac{1}{N} - \int_{\underline{q}}^{\bar{q}} \left[ \left( \frac{p^2}{q^2} - \alpha \right) \frac{1}{N} F(q) \right] dq$$

$$= r(p,\bar{q})\frac{1}{N} - E_q\left[ \frac{F}{f}(q)\frac{1}{N}\left( \frac{p^2}{q^2} - \alpha \right) \right]$$

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