A New Model of Advertising as a Signal for Goods with Differing Levels of Attribute Verifiability

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Abstract: This article presents a model of advertising as a signal that combines Nelson's "search" and "experience" goods with Darby and Karni's "credence" goods. It is the first to formalise these ideas in the same model allowing direct comparison of advertising levels for the different goods. The model predicts that equilibrium advertising levels increase the more difficult it is for consumers to observe true product quality, and that advertising can still function as a signal for credence goods. As well as noting the incentives facing low-quality producers to mimic the behaviour of high-quality producers, the article also notes the incentives to high-quality sellers to cheat consumers by producing lower quality.

INTRODUCTION

Early literature on the economics of advertising, as typified by Packard[1] and Galbraith[2], focused on its persuasive role and its ability to seemingly create desires in the minds of consumers. There was concern that consumer's purchase decisions reflected the preferences of producers and advertisers rather than their own, undermining assumptions key to welfare economics.

Later economists sought to explain advertising by its informative function, although this usually required strong assumptions about the nature of consumer choice.[3] The key implications of the informative models remained unchanged if firms provided false information through their advertisements. This neglected the powerful incentive for firms to deceive consumers into purchasing goods that they would not have purchased if they had complete information.

Phillip Nelson (1970, 1974) argued that if consumers behaved rationally, they would not be fooled by false advertising.[4] Nelson introduced the distinction between "search" and "experience" attributes, with the former being verifiable prior to purchase, and the latter only revealed following consumption of the good concerned.

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[1] V. Packard, *The Hidden Persuaders,* (1957).

[2] J. K. Galbraith, *The Affluent Society,* (1958): "These [institutions of modern advertising and salesmanship] cannot be reconciled with the notion of independently determined desires for their central function is to create desires – to bring into being wants that previously did not exist."

[3] G. J. Stigler and G. S. Becker, "De Gustibus Non Est Disputandem", *American Economic Review,* 67, (2), (1977); I. Ehrich and L. Fisher, "The Derived Demand for Advertising: A Theoretical and Empirical Investigation", *American Economic Review,* 72, (3), p.366-88, (1982); S. N. Wiggins and W. J. Lane, "Quality Uncertainty, Search, and Advertising", *American Economic Review,* 73, (5), p.881-94, (1983).

[4] P. Nelson, "Information and Consumer Behaviour", *Journal of Political Economy,* 78, (2), p.311-29, (1970); and "Advertising as Information", *Journal of Political Economy,* 82, (4), (1974).

Most goods can be seen to have a number of both types of attributes; when purchasing a car a consumer can immediately identify its style or colour – search attributes – but will only gain knowledge about the frequency with which consumables will need to be replaced after an extended period of ownership – an experience attribute. In what follows search goods will be defined as goods whose most important attributes can be assessed prior to purchase, and experience goods those whose most important attributes can only be verified in consumption.

Nelson asserted that there would be no false advertising for search goods, as the consumer can verify such details before purchasing the good, except where consumers incur a high cost in searching for the good and would rather buy a good found to have been falsely advertised than search again for an alternative. In the case of experience goods, however, a producer has made a sale before false advertising claims are discovered and the power of the consumer is limited to not repurchasing from the same producer. As all producers are free to make the same claims about the performance of their product, the rational consumer will ignore all such claims for experience goods.

Although advertising for experience goods can convey no direct information to consumers, they can use it to infer the quality of a good by observing the expenditure of a firm on advertising. If consumers recognise that high-quality sellers spend more on advertising they can use observed advertising levels as signals of product quality. To complete this argument, there needs to be a reason why advertising expenditures

and quality are positively correlated. Nelson's explanation was that high-quality sellers are more likely to get a repeat sale than low-quality sellers, and as such, the initial sale is (*ceteris paribus*) worth more to the high quality seller who is therefore willing to spend a greater amount on signalling to get that sale.

Nelson's ideas about advertising as a signal for experience goods were first formally modelled by Schmalensee (1978), who countered the argument by showing that low-quality sellers would have the highest advertising expenditures, especially when consumers behaved exactly in the way described by Nelson.[5] This result came from Schmalensee's assumption that the cost of producing quality was steeply increasing in quality. This meant that the initial sale was in fact worth more to low-quality producers as their mark-up was significantly higher than that of high-quality producers, and in Schmalensee's model consumers were unaware of this negative advertising-quality relationship.

Kihlstrom and Riordan (1984) again modelled Nelson's ideas to show that advertising could signal quality in the short run[6]. Their model was criticised by Milgrom and Roberts (1986) as prices are correlated with quality in the equilibrium, but are not used by consumers to infer the quality of goods.[7] Milgrom and Roberts were able to include price as an additional signal and show in equilibrium that both advertising and

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[5] R. Schmalensee, "A Model of Advertising and Product Quality", *Journal of Political Economy,* 86, (3), p.485-503, (1978).
[6] R. E Kihlstrom and M. H. Riordan, "Advertising as a Signal", *Journal of Political Economy,* 92, (3), p.427-50, (1984).
[7] P. Milgrom and J. Roberts, "Price and Advertising Signals of Product Quality", *Journal of Political Economy,* 94, (4), p.796-821, (1986).

sales are used simultaneously as quality signals by producers, with high-quality firms choosing more advertising then low-quality firms. Milgrom and Roberts themselves point out that their model says little about advertising for established brands, as it focuses on newly introduced goods.

An article by Darby and Karni (1973) introduced a third category of goods, which they termed "credence goods", whose properties cannot be evaluated in normal use.[8] The assessment of their value requires incurring additional costly expenditures or expert knowledge, examples being the calorie content of diet foods, or the removal of a healthy appendix. In the former case, assessment requires the use of laboratory equipment, and in the latter case, a patient is as fit after the operation as she would have been if the appendectomy were truly necessary.

For credence goods, false advertising by consumers would be harder for consumers to detect; it may take longer for deception to become apparent, or may not be identifiable at all. This article examines whether Nelson's mechanism for advertising as a signal could still operate if a good has credence qualities, and uniquely provides a single model of advertising for search, experience, and credence goods so that the equilibrium levels can be meaningfully compared.

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[8] M. R. Darby, and E. Karni, "Free Competition and the Optimal Amount of Fraud", *Journal of Law and Economics,* 16, p.67-88, (1973).

The basic model, in part I below, looks at a market for experience goods where advertising expenditures signal the quality of goods to consumers as described by Nelson. The later extensions, II through V, of the model look at search and credence goods and the effect of relaxing some of the assumptions of the model.

THE MODEL

I. The Basic Model: Experience Goods

The model has two periods ($t = 1,2$) and there are two producers, *L* and *H*, producing, exogenously given, low- and high-quality product respectively. Both firms have identical costs of production, assumed zero for simplicity.[9] They each discount the future at the same rate δ, and have sufficient production capacity to serve either the high- or low-quality consumers as defined below.

As the good is an experience good, all consumers are unable to observe the true quality of goods by inspection prior to purchase, but are able to observe it perfectly through consumption. There are two types of consumer, *l* and *h*, with different preferences which may be caused by differing income levels, tastes, or a wish to

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[9] Note: As mentioned above, these early assumptions will be relaxed later in the article, with differing costs of different levels of quality, and the high-quality firm free to choose the level of quality.

identify themselves as consumers of a certain level of quality. The first type of consumer, l, will buy from any producer selling at their low reservation price, p, but do not care about the level of quality. The other group of consumers, h, will only purchase high-quality goods, and are willing to pay a higher price p^h. It is assumed that revenues from the high-quality consumers are much greater than those from selling to low-quality consumers ($p.l < p^h.h$).

In what follows, advertising refers to expenditures by firms on advertising that provides no information to consumers. It is implicit that all firms must spend an equal amount on advertising that informs consumers of the product's existence and relates brand to function. This type of advertising is not the focus of this model and has been explored elsewhere[10], in what follows the level of this type of advertising is assumed to be negligible and set at zero.

Consumers observe the amount spent by each firm on advertising and take higher advertising expenditures as a signal of higher quality and h consumers purchase from the firm that advertises the most, or at random if firms advertise equally. Consumers are aware that different levels of quality are available, but do not know the distribution of qualities in the industry (i.e. that only one firm produces high-quality).

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[10] See, for example: G. M. Grossman and C. Shapiro, "Informative Advertising with Differentiated Products", *Review of Economic Studies,* 51, (1), p.63-81, (1984); and Y. Kotowitz and F. Mathewson, "Informative Advertising and Welfare", *American Economic Review,* 69, (3), (1979).

Consumption acts as a perfect indicator of product quality, so that in the second period consumers are fully informed about the quality of the producer whose goods they purchased in the first period. Initially it is assumed that producers will continue to produce the same level of quality in the second period as they did in the first period, as an extension of the earlier assumption of quality being exogenously given. Thus, h consumers will purchase from L in the first period if that firm advertises at least as much as firm H, but will not buy from L in the second period, even if L continues to advertise.

Equilibrium in this model is defined (following Spence (1973)[11]), as advertising choices by producers, which lead to purchase decisions by consumers that confirm the prior belief held by those consumers that higher advertising signals higher quality. In contrast to Spence (1973), it is the revenue accrued by firms rather than the cost of the signal that differentiates the signalling agents in this model.

There are four interesting cases to consider, where neither producer advertises at all, where both advertise equally, or where one firm advertises and the other does not. Both firms maximise their individual profits, π^j ($j = H,L$), in each period by choosing a level of advertising A_t ($t = 1,2$) and a price level, p or p^h. As production costs are assumed zero, profits in each case are given by the following:

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[11] M. Spence, "Job Market Signaling", *Quarterly Journal of Economics,* 87, (3), p.355-74, (1973).

NEITHER ADVERTISE: $\quad\quad\quad \pi^H = \pi^L = \frac{1}{2}p.l + (\delta)(\frac{1}{2}.p.l)$ $\quad\quad\quad\quad$ (1)

BOTH ADVERTISE EQUALLY: $\quad \pi^H = \frac{1}{2}p^h.h - A_1 + (\delta)(p^h.h - A_2)$ $\quad\quad$ (2.h)

$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad \pi^L = \frac{1}{2}p^h.h - A_1 + (\delta)(p.l)$ $\quad\quad\quad\quad\quad$ (2.l)

HIGH ADVERTISES: $\quad\quad\quad \pi^H = p^h.h - A_1 + (\delta)(p^h.h - A_2)$ $\quad\quad\quad$ (3.h)

$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad \pi^L = p.l + (\delta)(p.l)$ $\quad\quad\quad\quad\quad\quad\quad\quad$ (3.l)

LOW ADVERTISES: $\quad\quad\quad \pi^H = p.l + (\delta)(\frac{1}{2}p.l)$ $\quad\quad\quad\quad\quad\quad$ (4.h)

$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad \pi^L = p^h.h - A_1 + (\delta)(\frac{1}{2}p.l)$ $\quad\quad\quad\quad$ (4.l)

There are two situations that fulfil the above description for a signalling equilibrium: the first where neither seller advertises, and the second where the high-quality seller advertises and sells to high-quality consumers in both periods while the low-quality seller does not advertise. In both these cases consumer's expectations of quality, given information about advertising, are at least met. It is clear that the latter situation, where only *H* advertises, is preferred by every agent – including *H* when:

$$p^h.h - A_1 + (\delta)(p^h.h - A_2) > \frac{1}{2}p.l + (\delta)(\frac{1}{2}p.l) \quad\quad\quad (5)$$

It is assumed that *H* cannot advertise and make sales to *h* consumers in the situation where *L* was the higher advertiser in *t = 1*, as *h* consumers abandon the rule they assumed in the first period – that higher advertising signals higher quality – as this was proved incorrect by their first period consumption experience. This assumption

simplifies the solution of the model as well as adding some sophistication to consumer beliefs, allowing consumers first period consumption experience to alter their behaviour (not just their choices) in the second period.

The signalling problem for H is to set A in each period high enough to dissuade L from advertising. In the equilibrium scenario with only H advertising, the level of advertising in the second period will be greater than zero ($A_2 > 0$) for a number of reasons. Firstly, one might assume that if $A_2 = 0$ some h consumers may take this as a signal that H has stopped producing (or never did produce) high-quality goods, believing their own consumption experience to be an imperfect indicator of the true product quality. Secondly, L could set some positive level of advertising in the second period and capture some of the high quality market if H did not advertise.

Consumers may include some fraction $0 < \alpha < 1$, of the advertising observed in the first period in their second period evaluation of advertising expenditures. This represents consumer memory of past advertising expenditures, which is generally acknowledged to be present but declining over time. H must set A_2 high enough so that L would rather not advertise and sell to the low-quality consumers than advertise:

$$p^h.h - (A_2 + \alpha.A_1) < p.l$$

$$A_2 > p^h.h - p.l - \alpha.A_1 \qquad (6)$$

From what follows, if $\alpha = 1$ then A_2 may be set at zero: consumer's memory about advertising in the first period is sufficiently high to make the amount of expenditure

on advertising *L* must incur that it is never profitable to compete for the high-quality market in the second period. For some values of *α < 1,* there are positive advertising expenditures in the second period. In order to simplify the solutions that follow *α* is assumed to be zero; consumers are quick to forget advertising, or place a high weight on advertising in the current period for whatever reason.

Advertising in the model serves a dual purpose: to inform/remind consumers about the level of quality of a firm's product, and to dissuade low-quality firms from mimicking high-quality firms. In order to serve the second function and maximise profits *H* must set:

$$A_2 = p^h.h - p.l \tag{6*}$$

Thus, the profits in the equilibrium case can be rewritten as:

HIGH ADVERTISES: $\pi^H = p^h.h - A_1 + (\delta)(p.l)$ (3.h*)

$\pi^L = p.l + (\delta)(p.l)$ (3.l*)

H must set A_1 such that: i. *L* prefers not to advertise, and

ii. *H* prefers to advertise.

i.   (4.l) – (3.l*) < 0

ð $[p^h.h - A_1 + (\delta)(½p.l)] - [p.l + (\delta)(p.l)] < 0$

ð $A_1 > p^h.h - p.l - (\delta)(½p.l)$ (7.i)

And:

   ii. $(3.h^*) - (4.h) > 0$

        ð $[p^h.h - A_1 + (\delta)(p.l)] - [p.l + (\delta)(\tfrac{1}{2}p.l)] > 0$

        ð $A_1 < p^h.h - p.l + (\delta)(\tfrac{1}{2}p.l)$ (7.ii)

$$p^h.h - p.l + (\delta)(\tfrac{1}{2}p.l) > A_1 > p^h.h - p.l - (\delta)(\tfrac{1}{2}p.l) \qquad \textbf{(7*)}$$

The upper bound above is the maximum *H* would be willing to spend on advertising, given that the firm could choose to sell instead to the low-quality market. The lower bound is the minimum *H* must spend to discourage *L* from advertising in the first period: *H* will set advertising at this amount – solving the equation with equality to maximise profits.

Advertising in this model is:[12]

$$A_1 = p^h.h - p.l - (\delta)(\tfrac{1}{2}p.l) \qquad \textbf{(7*)}$$

$$And, \quad A_2 = p^h.h - p.l \qquad \textbf{(6*)}$$

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[12] Note that A_2 is lower for $\alpha > 0$

II. Extending the Model: Search Goods

The first extension of the model examines how the presence of search qualities affects the equilibrium level of signalling. Assume some fraction, $0 < \omega < 1$, of h consumers can determine the true quality of goods prior to purchase through costless search.[13] As in the initial case, consumption remains a perfect indicator of product quality. Here $\omega.h$ consumers will purchase from H regardless of the level of advertising of either firm, and so profits are now described by:

NEITHER: $\quad \pi^H = \frac{1}{2}.p.l + \omega.p.h + (\delta)(\frac{1}{2}.p.l + \omega.p.h)$ $\hfill$ (1.2.h)

$\quad\quad\quad\quad\quad\pi^L = \frac{1}{2}.p.l + (\delta)(\frac{1}{2}.p.l)$ $\hfill$ (1.2.l)

BOTH: $\quad\quad \pi^H = [(1+\omega)/2].p^h.h - A_1 + (\delta)(\ [(1+\omega)/2].\ p^h.h - A_2)$ $\hfill$ (2.2.h)

$\quad\quad\quad\quad\quad\pi^L = [(1-\omega)/2].p^h.h - A_1 + (\delta)(p.l)$ $\hfill$ (2.2.l)

HIGH: $\quad\quad \pi^H = p^h.h - A_1 + (\delta)(\ p^h.h - A_2)$ $\hfill$ (3.2.h)

$\quad\quad\quad\quad\quad\pi^L = p.l + (\delta)(p.l)$ $\hfill$ (3.2.l)

LOW: $\quad\quad \pi^H = p.l + \omega.p.h + (\delta)(\frac{1}{2}p.l + \omega.p.h)$ $\hfill$ (4.2.h)

$\quad\quad\quad\quad\quad\pi^L = (1-\omega).p^h.h - A_1 + (\delta)(\frac{1}{2}p.l)$ $\hfill$ (4.2.l)

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[13] Note: This assumption is very similar to that of Hahn (2004), which will be described later.

In the equilibrium case, revenues to the two firms are unchanged – except for the change in the amount of advertising described below. The payoff to *L* of mimicking a high-quality producer, equation (4.2.l), has fallen by $\omega.p^h.h$ in the first period. In the second period *L* would only receive $(1 - \omega).p^h.h$ if it advertised more than *H*, so – as before – *H* must set A_2 such that:

$$(1 - \omega).p^h.h - A_2 < p.l$$

And to maximise profits will set:

$$A_2 = (1 - \omega).p^h.h - p.l \qquad (6.2^*)$$

Note that this is lower than in the first case [where $A_2 = p^h.h - p.l$] and may be zero (even when $\alpha = 0$) if ω is sufficiently large:

$$A_2 = 0, \text{ if:} \qquad (1 - \omega).p^h.h - p.l \leq 0$$

$$1 - \omega \leq (p.l)/(p^h.h)$$

$$\omega \geq 1 - (p.l)/(p^h.h)$$

Profits in the equilibrium case can now be rewritten:

HIGH: $\qquad \pi^H = p^h.h - A_1 + (\delta)(\omega.p^h.h + p.l)$ $\qquad\qquad$ (3.2.h*)

$\qquad\qquad \pi^L = p.l + (\delta)(p.l)$ $\qquad\qquad\qquad\qquad\qquad$ (3.2.l*)

H must set A_1 such that: $\qquad$ i. *L* prefers not to advertise, and

$\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ ii. *H* prefers to advertise.

$\qquad$ i. $\qquad\qquad$ (4.2.l) – (3.2.l*) < 0

$\qquad$ ð $\qquad$ *[(1 – ω).p^h.h – A_1 + (δ)(½p.l)] – [p.l + (δ)(p.l)] < 0*

$\qquad$ ð $\qquad$ *A_1 > (1 – ω). p^h.h – p.l – (δ)(½p.l)* $\qquad\qquad\qquad$ (7.2.i)

And:

ii. $(3.2.h^*) - (4.2.h) > 0$

$\eth$ $[p^h.h - A_1 + (\delta)(\omega.p^h.h + p.l)] - [p.l + \omega.p.h + (\delta)(\frac{1}{2}p.l + \omega.p.h)] > 0$

$\eth$ $A_1 < p^h.h - p.l - \omega.p.h + (\delta)(\omega.p^h.h - \omega.p.h + \frac{1}{2}p.l)$ (7.2.ii)

$$p^h.h - p.l - \omega.p.h + (\delta)(\omega.p^h.h - \omega.p.h + \frac{1}{2}p.l) > A_1 > (1 - \omega).\, p^h.h - p.l - (\delta)(\frac{1}{2}p.l) \qquad \textbf{(7.2*)}$$

As in the first case, H will set A_1 at its minimum value. Note as before for $t = 2$,

advertising may be zero in the first period if ω is sufficiently high:

$$A_1 = 0, \text{ if:} \qquad (1 - \omega)\, p^h.h - p.l - (\delta)(\frac{1}{2}p.l) \leq 0$$

$$1 - \omega \leq [p.l + (\delta)(\frac{1}{2}p.l)]/(p^h.h)$$

$$\omega \geq 1 - [(1 + \delta/2)(p.l)/(p^h.h)]$$

Advertising in the search good case is:

$$A_1 = (1 - \omega).\, p^h.h - p.l - (\delta)(\frac{1}{2}p.l) \qquad \textbf{(7.2*)}$$

$$\textbf{And, } A_2 = (1 - \omega).p^h.h - p.l \qquad \textbf{(6.2*)}$$

III. Extending the Model: Credence Goods

From the basic model, this time it is assumed that some fraction $0 < \theta < 1$ of h consumers cannot verify the true quality of a good even after consumption. Thus, if they purchase from the low-quality seller in the first period, they will be happy to do so again in $t = 2$. Profits in this case are defined by:

NEITHER: $\pi^H = \pi^L = \frac{1}{2}.p.l + (\delta)(\frac{1}{2}.p.l)$ (1.3)

BOTH: $\pi^H = \frac{1}{2}.p^h.h - A_1 + (\delta)(\frac{1}{2}.p^h.h - A_2)$ (2.3.h)

$\pi^L = \frac{1}{2}.p^h.h - A_1 + (\delta)([\theta/2].p.h + p.l)$ (2.3.l)

HIGH: $\pi^H = p^h.h - A_1 + (\delta)(p.l)$ (3.3.h*)

$\pi^L = p.l + (\delta)(p.l)$ (3.3.l*)

LOW (a): $\pi^H = p.l + (\delta)(p.l)$ (4.3.h.a)

$\pi^L = p^h.h - A_1 + (\delta)(\theta.p^h.h - A_2)$ (4.3.l.a)

LOW (b): $\pi^H = p.l + (\delta)(\frac{1}{2}p.l)$ (4.3.h.b)

$\pi^L = p^h.h - A_1 + (\delta)(\theta.p.h + \frac{1}{2}p.l)$ (4.3.l.b)

As in the first case, H sets $A_2 = p^h.h - p.l$. In the scenario where L advertises the most in $t = 1$, L may choose to advertise in the second period and continue to sell at the

higher price to the $\theta.h$ consumers who were unable to tell that the product they bought in the first period was in fact low-quality (*(a)* above). In order to dissuade H from advertising more in the second period and selling to those consumers (as their prior beliefs have been disconfirmed, the other *(1 – θ).h* will not purchase at all in the second period, as described in the initial model), L must set A_2 such that:

$$\theta.p^h.h - A_2 \leq p.l$$

And so will set: $A_2 = \theta.p^h.h - p.l$ (6.3.l*)

L's payoff in this situation will be: $\pi^L = p^h.h - A_1 + (\delta)(p.l)$ (4.3.l.a*)

Alternatively, L could choose to advertise in the first, but not the second period *(b)*. L will choose to advertise in the second period if:

$$p.l > \theta.p.h + \tfrac{1}{2}p.l$$

   if: *θ < ½.l/h*

Thus, there are two cases to consider when L is the higher advertiser in the first period, *(a)* where L advertises in the second period (when *θ < ½.l/h*), and *(b)* where L advertises in the first period only (when *θ > ½.l/h*). The solutions for A_1 in these two different scenarios are given below:

(a) *θ < ½.l/h*: H must set A_1 such that: i. L prefers not to advertise, and

                                                               ii. H prefers to advertise.

   i.   (4.3.l.a*) – (3.3.l*) < 0

        ê   *[p^h.h – A_1 + (δ)(p.l)] – [p.l + (δ)(p.l)] < 0*

        ê $A_1 > p^h.h – p.l$ (7.3.a.i)

And:

    ii. $(3.3.h^*) - (4.3.h.a) > 0$

        ê   *[p^h.h – A_1 + (δ)(p.l)] – [p.l + (δ)(p.l)] > 0*

        ê   *A_1 < p^h.h – p.l*   (7.3.a.ii)

$$\boldsymbol{p^h.h - p.l > A_1 > p^h.h - p.l} \qquad \textbf{(7.3.a*)}$$

(b) *θ > ½.l/h*: *H* must set *A_1* such that: i. *L* prefers not to advertise, and

                                            ii. *H* prefers to advertise.

    i. $(4.3.l.b^*) - (3.3.l^*) < 0$

        ê   *[p^h.h – A_1 + (δ)(θ.p.h + ½p.l)] – [p.l + (δ)(p.l)] < 0*

        ê   *A_1 > p^h.h – p.l + (δ)(θ.p.h – ½p.l)*   (7.3.b.i)

And:

    ii. $(3.3.h^*) - (4.3.h.b) > 0$

        ê   *[p^h.h – A_1 + (δ)(p.l)] – [p.l + (δ)(½p.l)] > 0*

        ê   *A_1 < p^h.h – p.l + (δ)(½p.l)*   (7.3.b.ii)

$$\boldsymbol{p^h.h - p.l + (\delta)(½p.l) > A_1 > p^h.h - p.l + (\delta)(\theta.p.h - ½p.l)} \qquad \textbf{(7.3.b*)}$$

The first case, *(a),* can be seen as a special example of the credence good case, where the low-quality producer advertises in both periods and the high-quality producer does not.

Advertising in the second case, *(b),* is given by:

$$\boldsymbol{A_1 = p^h.h - p.l + (\delta)(\theta.p.h - ½p.l)} \qquad \textbf{(7.3.b*)}$$

$$\textbf{And, } \boldsymbol{A_2 = p^h.h - p.l} \qquad \textbf{(6.3.h*)}$$

IV. Extending the Model: Perfect Credence

If $\theta = 1$, the output of the two firms is effectively identical, as all consumers are unable to tell between the two levels of quality. In this case, the payoffs to the two firms become symmetrical:

NEITHER: $\quad \pi^H = \pi^L = \frac{1}{2}p.l + (\delta)(\frac{1}{2}p.l)$ $\qquad\qquad\qquad\qquad$ (1.4)

BOTH: $\qquad \pi^H = \pi^L = \frac{1}{2}p^h.h - A_1 + (\delta)(\frac{1}{2}.p^h.h - A_2)$ $\qquad\qquad$ (2.4)

HIGH: $\qquad \pi^H = p^h.h - A_1 + (\delta)(p^h.h - A_2)$ $\qquad\qquad\qquad$ (3.4.h)

$\qquad\qquad\quad \pi^L = p.l + (\delta)(p.l)$ $\qquad\qquad\qquad\qquad\qquad\qquad$ (3.4.l)

LOW: $\qquad \pi^H = p.l + (\delta)(p.l)$ $\qquad\qquad\qquad\qquad\qquad\qquad$ (4.4.h)

$\qquad\qquad\quad \pi^L = p^h.h - A_1 + (\delta)(p^h.h - A_2)$ $\qquad\qquad\qquad$ (4.4.l)

Note now that both scenarios when either low or high advertises the most represent equilibria as initially defined. The game can no longer be solved as a simultaneous game, as it is now a form of the classic "chicken game". This can now only be solved if one of the players can pre-commit first to some level of advertising in each period such that:

$\qquad\qquad p^h.h - A_t < p.l$

Thus, $\qquad \boldsymbol{A_1 = A_2 = p^h.h - p.l}$ $\qquad\qquad\qquad\qquad\qquad$ **(6/7.4*)**

These advertising levels give both firms the same payoff in both periods of $p.l$, so that the first mover would be indifferent between advertising and selling at p^h and not advertising, except where $\alpha > 0$, in which case second period advertising can be lower and profits to the advertising firm will be higher.

V. Extending the Model: Endogenising Quality

The model as explored above looked at the incentives for a low-quality seller to mimic the behaviour of a high-quality seller and make sales through false signalling. The analysis above ignores the incentive of the high-quality seller to "cheat" consumers by producing low- rather than high-quality products. To explore this simply, it is assumed that H incurs some fixed cost c_q in each period that it chooses to produce high quality, and is free to choose low quality instead.

Experience Goods

In the equilibrium situation *H's* payoff to producing high quality will be:

$$\pi^H = p^h.h - A_1 - c_q + (\delta)(p^h.h - A_2 - c_q)$$

$$[A_1 = p^h.h - p.l - (\delta)(\tfrac{1}{2}p.l), A_2 = p^h.h - p.l]$$

$$\pi^H = p.l + (\delta)(\tfrac{1}{2}p.l) - c_q + (\delta)(p.l - c_q)$$

However, if H chose to produce low-quality in $t = 2$, it would loose no sales but gain $(\delta)(c_q)$, increasing profits to:

$$\pi^H = p.l + (\delta)(\tfrac{1}{2}p.l) - c_q + (\delta)(p.l)$$

The optimal strategy for H at $t = 2$ is to cheat and produce low quality, except where there exists an external mechanism, such as a legal framework, which punishes such actions. These considerations are explored more fully below.

If H chose to produce low-quality products in the first period, it would not be able to make any sales to h consumers at $t = 2$, but would have to share the low-quality market with L. Therefore H would choose to produce low-quality in both periods, if:

$$p^h.h - A_1 - c_q + (\delta)(p.l) < p^h.h - A_1 + (\delta)(\tfrac{1}{2}p.l)$$

$$c_q > (\delta)(\tfrac{1}{2}p.l)$$

H will choose to cheat in the first period only if the cost of producing high-quality products in that period, c_q, is greater than the returns to doing so, $(\delta)(\tfrac{1}{2}p.l)$. If $\alpha > 0$ the threshold level of c_q for H to cheat is higher.

Search Goods

In the equilibrium situation $H's$ payoff to producing high quality is:

$$\pi^H = p^h.h - A_1 - c_q + (\delta)(p^h.h - A_2 - c_q)$$

$$[A_1 = (1 - \omega) p^h.h - p.l - (\delta)(\tfrac{1}{2}p.l), A_2 = (1 - \omega)p^h.h - p.l]$$

$$\pi^H = \omega.p^h.h + p.l + (\delta)(\tfrac{1}{2}p.l) - c_q + (\delta)(\omega.p^h.h + p.l - c_q)$$

If H were to produce low quality in the second period, it would gain c_q in that period, but lose $\omega.h$ sales from those consumers who are able to correctly identify product quality prior to purchase. *H's* payoff would be:

$$\pi^H = \omega.p^h.h + p.l + (\delta)(\tfrac{1}{2}p.l) - c_q + (\delta)(p.l)$$

Thus, H would continue to produce high quality in $t = 2$, unless $c_q > \omega.p^h.h$.

H would choose to cheat in both periods if:

$$p^h.h - A_1 - c_q + (\delta)(p.l) < (1 - \omega)p^h.h - A_1 + (\delta)(\tfrac{1}{2}p.l)$$

$$c_q > \omega.p^h.h + (\delta)(\tfrac{1}{2}p.l)$$

This is $\omega.p^h.h$ greater than in the experience case.

Credence Goods

As in the experience good case above, H will choose to cheat and produce low quality in the second period for all positive values of c_q. If H were to cheat in the first period it would gain c_q in the first period and lose $(1 - \theta)h$ sales in the second period; H would choose to cheat in both periods if:

$$c_q > (\delta)(1 - \theta)p^h.h$$

Perfect Credence

If $\theta = 1$, H will choose to cheat in all periods, for all positive values of c_q.

IMPLICATIONS OF THE MODEL

a. Comparing Advertising Levels

Type of Good		A_1	A_2
Search	$1 > \omega > 1 - p.l/p^h.h$	0	0
	$1 - p.l/p^h.h > \omega > 1 - (1 + \delta/2)p.l/p^h.h$	0	$(1 - \omega)p^h.h - p.l$
	$1 - (1 - \delta/2)p.l/p^h.h > \omega > 0$	$(1 - \omega)p^h.h - p.l - (\delta)(\frac{1}{2}p.l)$	$(1 - \omega)p^h.h - p.l$
Experience	$\omega = 0, \theta = 0$	$p^h.h - p.l - (\delta)(\frac{1}{2}p.l)$	$p^h.h - p.l$
Credence	$0 < \theta < 1$	$p^h.h - p.l - (\delta)(\theta.p.h - \frac{1}{2}p.l)$	$p^h.h - p.l$
	$\theta = 1$	$p^h.h - p.l$	$p^h.h - p.l$

Note that the earlier assumptions that all firms are free to choose advertising independently in each period, and that h consumers purchase from the firm with the greatest advertising expenditures observed in each period, are sufficient to ensure that advertising in the second period is greater than zero (except for some values of ω). This answers the Horstmann and MacDonald (1994) criticism of earlier models of advertising as a signal, specifically; that advertising is unnecessary in the second period as the issue of quality is settled by the signalling in the first period.[14]

Advertising remains viable as a Nelson-type signal for goods that have credence qualities, with signalling levels greater than for experience goods – which, in turn, have more advertising than search goods. The less likely consumers are to detect

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[14] I. J. Horstmann and G. M. MacDonald, "When is Advertising a Signal of Product Quality", *Journal of Economics and Management Strategy,* 3, (3), p.561-84, (1994). Note also that the model survives their second criticism of such models, that "Consumer's experience plays no independent role in shaping subsequent consumption behaviour."

low-quality product, or the slower they are to act on such knowledge, the greater are the returns to mimicry and thus the greater the level of advertising in equilibrium. It is clear from the table above that advertising expenditures increase the more difficult it is for consumers to verify product attributes.

b. Incentive to Cheat

In the model above, not only do low-quality firms have an incentive to fool consumers by mimicking the signalling behaviour of high-quality firms, but the latter firms themselves also have an incentive to "cheat" consumers and save on production costs by producing lower quality. The following table presents the values of c_q that will cause H to cheat, and produce low rather than high quality, in each period.

Type of Good:	t = 1	t = 2
Search	$c_q > \omega.p^h.h + (\delta)(\frac{1}{2}p.l)$	$c_q > \omega.p^h.h$
Experience	$c_q > (\delta)(\frac{1}{2}p.l)$	$c_q > 0$
Credence	$c_q > (\delta)[(1 - \theta) p^h.h]$	$c_q > 0$
Perfect Credence	$c_q > 0$	$c_q > 0$

For all types of goods, except some search goods, it is the optimal strategy for H to cheat and produce low quality in the second period as long as high-quality production is more expensive. The harder it is for consumers to recognise such cheating, the greater is the incentive for H to cheat in all periods. If the quality choice must be made once-and-for-all in the first period, this will prevent H from cheating in each

case as long as the cost of producing high quality is low enough. For perfect credence goods, it never pays H to voluntarily choose to produce high quality.

However, if h consumers are able to observe the payoffs to high-quality firms in $t = 2$, they will know that no high-quality product will be produced in that period and not purchase anything – the market disappears in that period. As Nelson (1974)[15] asserts, the circumstances in which advertisers have the greatest incentive to deceive are the circumstances under which consumers would be least likely to believe such advertising.

Firms have an incentive to cheat consumers by reducing costs by lowering product quality, except where there are automatic or artificial penalties for so doing. In the first period of the above model for most goods, there exists the automatic penalty of lost repeat sales. In the second period, this automatic mechanism is absent and the quantity traded will fall to zero in the high-quality market if consumers are aware of the incentives facing firms.

The legal framework within which firms operate in most nations provides an artificial mechanism to prevent firms from cheating. Even for credence goods, where individual consumers may be unable to detect low product quality, a firm's competitors may have the technical knowledge or equipment necessary to do so. Competitive firms have an incentive to monitor the output of competitors and

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[15] P. Nelson, "Advertising as Information", *Journal of Political Economy,* 82, (4), 1974

publicise deception if discovered, with this being constrained to the truth by legal restrictions on libellous claims. Some goods might also come under government scrutiny, with official prosecution resulting in corporate fines. Consumers realising that they have been deceived by firms may also use the courts to seek compensation.

However, the legal framework only works in this way if firms have made *specific* claims about the quality of their goods in their advertising, which are unnecessary under the assumptions of Nelson (1974). This is why such punishments have been omitted from the model as described above for low-quality firms who mimic the behaviour of high-quality firms. These legal constraints could be seen to apply if the decisions of consumers were not based on the amount of advertising they observe, but instead on the advertisements they observe that make specific claims about high product quality. The question then becomes one of commitment to such messages rather than of signalling.

The incentive for firms to cheat consumers in this way is not unique to this model, or to credence goods, but to all cases where the cost of producing high quality is greater than the sales lost by not doing so. In reality, producer-consumer interaction is rarely a finite game, so the above analysis exaggerates the incentives for firms to cheat. The analysis could be extended to include more periods, but the conclusions of such a model would be essentially the same as for the two-period model described here.

c. Welfare

The term "advertising", as used above, referred to any expenditure by firms that was observed by consumers on any form of promotion or packaging of goods, and especially referring to advertisements that provided no direct information to consumers. This includes the firm simply burning large amounts of cash, if it was observed by consumers. As defined, such advertising is socially wasteful, except for the quality-assurance function it provides to consumers.

The above model gives the strong result that such wasteful activity is positively correlated with consumer difficulty in observing true product quality. However, to judge if the level of signalling is excessive, the value of the quality assurance it provides must be determined. This is likely to vary, not only between search, experience, and credence goods, but also for specific goods within these categories. Evaluation of social welfare must therefore be done on a good by good basis.

The article by Masters and Sanogo (2002) performs such an analysis.[16] It looks at the market for infant foods in Mali, where the dominant brand – Nestlé's *"Cérélac"* – is heavily advertised and expensively packaged, retailing at a high premium over nutritionally equivalent generic products. The nutritional value of such products is a credence attribute which cannot be observed by individual mothers but is very important in ensuring infant health.

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[16] W. A. Masters and D. Sanogo, "Welfare Gains from Quality Certification of Infant Foods: Results from a Market Experiment in Mali", *American Journal of Agricultural Economics,* 84, (4), p.974-89, (2002).

Masters and Sanogo used a market-simulation experiment to determine consumers willingness-to-pay for quality information, distinguishing this from the premia paid for brand identity, packaging, and processing.[17] They concluded that roughly one third of the price paid for *Cérélac* represented willingness-to-pay for quality certification, and in aggregate, this greatly exceeded the cost of instituting a voluntary quality certification program in Mali.

EMPIRICAL EVIDENCE

Nelson noted the difficulty of performing meaningful empirical tests using his definitions of search and experience goods. The definitions do not give precise guidelines as to which products should be included in each group, and many goods can be seen to have a mix of both types of attribute. The introduction of the third category, of credence goods, can only complicate this problem further. Without objective groupings of products, any test of the model above using empirical data becomes highly subjective.

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[17] Masters and Sanogo (2002) used an exchange process to elicit the preferences of Malian mothers. The mothers were promised a can of *Cérélac,* or an equivalent (that they would themselves choose) for their participation in the survey. They were asked to state how much of a similar product – in a sealed bag labelled as nutritionally equivalent to *Cérélac* by Mali's national agricultural research service – they would exchange for the can of *Cérélac*. The mother's choices were recorded and placed in a box to be drawn at random at the end of the survey, with the mother receiving whatever was specified on the card drawn. The experiment also featured exchanges between the second product and another similar product in an open bag without quality certification, and then between that product and a quantity of the product's raw materials. In this way the first part of the experiment revealed the mother's willingness-to-pay for branding and packaging, with the second step revealing willingness-to-pay for quality assurance and the last part the value to the mother of processing.

Table 3: Advertising/Sales Ratios by Category UK, 2001[18]				
Product Category	Consumers' Expenditure £m	Advertising £'000	Ad/Sales Ratio	Ad/Sales Rank
Toiletries and cosmetics	6,237	363,966	5.84	1
Pharmaceuticals	2,261	104,651	4.63	2
Leisure & personal	20,852	451,867	2.17	3
Domestic appliances & electronic equipment	10,991	222,929	2.03	4
Household stores	6,341	93,032	1.47	5
Services	20,196	218,182	1.08	6
Gambling	5,610	51,222	0.91	7
Motoring	76,262	674,359	0.88	8
Gardening	1,942	13,739	0.71	9
Food (excluding catering)	69,977	474,583	0.68	10
Household equipment	15,419	103,636	0.67	11
Travel & tourism	49,478	300,888	0.61	12
Beverages	54,035	320,590	0.59	13
Clothing and footwear	30,389	161,618	0.53	14
Smoking	13,282	21,327	0.16	15
Domestic fuel and lighting	14,063	8,150	0.06	16

Nelson tested his hypotheses by grouping products into search and experience categories and comparing the average advertising to sales ratios of the two groups.[19] The tables presented here hope to illustrate this point in reverse, by listing the top advertisers in the UK and allowing for the argument that the highest are credence goods.

The two top categories in Table 3 above are *toiletries and cosmetics,* and *pharmaceuticals*; products which have attributes, or make claims that are not testable by individual consumers in normal consumption. A large proportion of the goods listed above are most easily thought of as experience goods, but with the true quality of some taking longer to become apparent than others. *Domestic appliances* represent

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[18] Source: The Advertising Association / the World Advertising Research Center Ltd., *Advertising Statistics Yearbook 2003.*
[19] See table 1, p.739, in P. Nelson, "Advertising as Information", *Journal of Political Economy,* 82, (4), (1974).

experience goods that are relatively expensive and infrequently replaced, and as such are close to being credence goods. The category of *food* includes some fresh produce which is evaluable by search, but also packaged food products which cannot be judged at the point of purchase. Nelson cited *clothing* as a search good and this appears low down on the above list.

Table 4 expands on these categories, and shows both lawn fertilisers and bleaches also have high advertising/sales ratios. The former has observed performance that is severely affected by external factors, such as weather conditions, and the latter has actual performance, the killing of germs, which is unobservable outside of a laboratory setting.

Table 4: Top Ten Advertising/Sales Ratios by Product UK 2001[20]			
Product Category	**Consumers' Expenditure £m**	**Advertising £'000**	**Ad/Sales Ratio %**
Shampoos	274	55,278	20.17
Denture fixatives	18	5,289	29.38
(total toiletries & cosmetics)	*6,237*	*363,966*	*5.84*
Bottled sauces	165	19,457	11.79
Condiments	53	6,747	12.73
Lawn fertilisers	34	4,132	12.15
Bleaches & lavatory cleaners	41	10,459	25.51
Cough liquids	97	10,959	11.30
Indegestion remedies	95	10,358	10.90
Smoking cessation	65	9,338	14.37
Sleeping aids	13	1,621	12.47
(total pharmaceuticals)	*2,261*	*104,651*	*4.63*

[20] Source: The Advertising Association / the World Advertising Research Center Ltd., *Advertising Statistics Yearbook 2003.*

The above data appears, at first sight, to support the model's implications. The use of advertising/sales ratios in such an argument can be misleading, however, as products can have high ratios mainly because of their low sales, rather than high advertising levels. Also, advertising expenditures must also be seen in a wider context; with the competitive nature of the market, the choice of advertising medium, and the ability to target consumers effectively all having a significant impact on firm's advertising choices.

CONCLUSION

The model above presented a unique formal representation of the ideas of Nelson (1970, 1974)[21], combined with the additional insight of Darby and Karni (1973)[22]. In so doing, it was able to conclude that the level of signalling through advertising increases with increased the difficulty for consumers of determining the true level of quality, and that advertising can remain a signal of product quality when a good has credence attibutes.

This article was not the first to formalise the ideas of either Nelson, or Darby and Karni, but the first to present both simultaneously using the same model. Nelson's

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[21] P. Nelson, "Information and Consumer Behaviour", *Journal of Political Economy,* 78, (2), p.311-29, (1970); and "Advertising as Information", *Journal of Political Economy,* 82, (4), (1974).
[22] M. R. Darby, and E. Karni, "Free Competition and the Optimal Amount of Fraud", *Journal of Law and Economics,* 16, p.67-88, (1973).

ideas are probably best presented in Milgrom and Roberts (1986)[23] as described above. Recently Hahn (2004)[24] presented a model of advertising as a signal for credence goods, following Darby and Karni, and using the analysis of Milgrom and Roberts.

Hahn's assumptions about the nature of such goods, and the subsequent analysis, differs significantly from that described above; Hahn assumed that credence goods can be evaluated by a proportion of consumers perfectly and costlessly prior to purchase, with other consumers ignorant of their true quality even after consumption. This is very close to the presentation of search goods in this article, and although Hahn's model includes price as a signal and has only a single period and a monopoly producer. However, the equilibrium level of advertising in each model is the same; with $c^H = u^H(1 - x) - u^L$ in Hahn's notation corresponding almost exactly with this article's notation of $A = p^H.h(1 - \omega) - p.l$.

Hahn's analysis lacks the second period of this article, and essentially looks at a slightly different type of credence good. In Hahn's model the good is one that experts may judge prior to purchase and in this article the good is one that is either judged only by experts in consumption, or one for which consumption experience is an imperfect indicator of quality so that only a fraction of consumers can adequately

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[23] P. Milgrom and J. Roberts, "Price and Advertising Signals of Product Quality", *Journal of Political Economy,* 94, (4), p.796-821, (1986).
[24] S. Hahn, "The Advertising of Credence Goods as a Signal of Product Quality", *The Manchester School,* 72, (1), p.50-59, (2004).

judge it. The interpretations of both articles may differ, but they are both consistent with the ideas of Darby and Karni (1973).

The model presented in this article could be extended to include additional signals or periods, but this would add little, if anything, to the existing analysis here and elsewhere in the literature. This article is able to describe a situation where advertising remains a signal when a good has credence qualities, and provides a comparison of advertising levels for different types of goods without these added complications. The difficulties of general economic welfare judgements based on the above model and objective empirical tests of its implications have been noted above.

BIBLIOGRAPHY

- The Advertising Association / the World Advertising Research Center Ltd., *'Advertising Statistics Yearbook 2003'*

- G. S. Becker and K. M. Murphy, "A Simple Theory of Advertising as a Good or Bad", *Quarterly Journal of Economics,* 108, (4), 1993

- G. R. Butters, "Equilibrium Distributions of Sales and Advertising Prices", *Review of Economic Studies,* 44, (3), p.465-91, 1977

- M. R. Darby, and E. Karni, "Free Competition and the Optimal Amount of Fraud", *Journal of Law and Economics,* 16, p.67-88, 1973

- A. K. Dixit and V. Norman, "Advertising and Welfare", *Bell Journal of Economics,* 1977

- Ehrich and L. Fisher, "The Derived Demand for Advertising: A Theoretical and Empirical Investigation", *American Economic Review,* 72, (3), p.366-88, 1982

- J. K. Galbraith, *'The Affluent Society',* 1958

- G. M. Grossman and C. Shapiro, "Informative Advertising with Differentiated Products", *Review of Economic Studies,* 51, (1), p.63-81, 1984

- S. Hahn, "The Advertising of Credence Goods as a Signal of Product Quality", *The Manchester School,* 72, (1), p.50-59, 2004

- O. Hochman and I. Luski, "Advertising and Economic Welfare: Comment", *American Economic Review,* 78, (1), p.290-6, 1988

- I. J. Horstmann and G. M. MacDonald, "When is Advertising a Signal of Product Quality", *Journal of Economics and Management Strategy,* 3, (3), p.561-84, 1994

- B. Huey, "Advertising's Double Helix: A Proposed New Process Model", *Journal of Advertising Research,* 39, (3), 1999

- S. P. Jain and S. S. Posavac, "Prepurchase Attribute Verifiability, Source Credibility, and Persuasion", *Journal of Consumer Psychology,* 11, (3), 2001

- B. Javanovic, "Truthful Disclosure of Information", *Bell Journal of Economics,* 13, (1), 1982

- R. E Kihlstrom and M. H. Riordan, "Advertising as a Signal", *Journal of Political Economy,* 92, (3), p.427-50, 1984

- Y. Kotowitz and F. Mathewson, "Informative Advertising and Welfare", *American Economic Review,* 69, (3), 1979

- H. S. Krishman and R. E. Smith, "The Relative Endurance of Attitude Confidence and Attitude-Behaviour Consistency: The Role of Information Source and Delay", *Journal of Consumer Psychology,* 7, (3), 1998

- D. N. Laband, "Advertising as Information: An empirical note", *Review of Economics and Statistics,* 68, (3), p.517-21, 1986

- W. A. Masters and D. Sanogo, "Welfare Gains from Quality Certification of Infant Foods: Results from a Market Experiment in Mali", *American Journal of Agricultural Economics,* 84, (4), p.974-89, 2002

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

- P. Nelson, "Information and Consumer Behaviour", *Journal of Political Economy,* 78, (2), p.311-29, 1970

- P. Nelson, "Advertising as Information", *Journal of Political Economy,* 82, (4), 1974

- L. M. Nichols, "Advertising and Economic Welfare", *American Economic Review,* 75, (1), p.213-8, 1985

- V. Packard, *'The Hidden Persuaders',* 1957

- R. Schmalensee, "A Model of Advertising and Product Quality", *Journal of Political Economy,* 86, (3), p.485-503, 1978

- M. Spence, "Job Market Signaling", *Quarterly Journal of Economics,* 87, (3), p.355-74, 1973

- G. J. Stigler and G. S. Becker, "De Gustibus Non Est Disputandem", *American Economic Review,* 67, (2), 1977

- L. G. Telser, "Supply and Demand for Advertising Messages", *American Economic Review,* 56, 1966

- S. N. Wiggins and W. J. Lane, "Quality Uncertainty, Search, and Advertising", *American Economic Review,* 73, (5), p.881-94, 1983