‘Hidden Quality’ in the History of American Food: Consumer Search vs. Industry Obfuscation?*†

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> The product of the large, nationally advertising...canners is for the most part of mediocre quality; and this must be so, since the scale of their output does not permit them to select from the best...The companies have naturally resisted efforts to have all cans carry a grade mark indicating the quality of the contents. Imagine the effect on Del Monte advertising and prices, for example, of B and C grade marks on Del Monte cans.
>
> –Arthur Kallet, consumer advocate (1934)

1 Introduction

In 1933, "Big Food" was under attack. Newly developed laboratory tests had demonstrated that the canning process destroys vitamins in food, a number of deadly "diseases of malnutrition" had been tied to dietary deficiencies in these vitamins, and–to make things worse–a number of high-profile cases had come to light in which adulterated canned goods had resulted in scores of poisoning deaths. The public had developed a deep distrust of processed foods, and many were calling on Congress to act (Levenstein, 1988, 1993).

Economists today understand that when quality is unobservable, markets for high-quality goods will tend to collapse. Modern economic theory also points to a relatively simple policy solution: credible third-party quality certification systems (Akerlof, 1970; Darby and Karni, 1973). Consumer and public health advocates of the 1930s understood this as well, and a high profile political battle ensued (Kallet, 1934; Lamb, 1936).

It might seem, at first blush, that there was not much room for debate in this case. People were dying, consumers clearly wanted more information about the foods they were consuming, and if they did not get it the industry would suffer. But as the quotation above from contemporary observer Kallet illustrates, things were not so simple. The largest industrial canners did indeed favor a minimum-quality standard, which would essentially declare substandard products to be inedible. But at higher quality levels the largest canners did not enjoy a comparative advantage, and expansion of these markets would cause them to lose market share.

The way in which the debate played out is also informative. The large food processors aggressively lobbied Congress and the White House, but they also mounted a larger public relations campaign in order to convince their customers. The editorial boards of the nationally circulating magazines *Good Housekeeping* and *Ladies' Home Journal*, for example, were forced into embarrassing reversals when it became clear the their initial support for strong, clear food quality standards posed a threat to their largest advertisers. Similarly, lavish rewards were waiting for leading nutrition scientists, such as Harvey Wiley and Elmer McCollum, in exchange for prominently placed reassuring words about the quality and safety of America's favorite brand name foods. When Congress finally passed the *Food, Drug, and Cosmetic Act* of 1938, strong quality grading provisions were not included (Levenstein, 1993).

In broad outline, this episode is far from unique in the history of American food. Economies of scale in brand promotion, processing, and distribution have often resulted in just a few large firms dominating various corners of the food industry; higher-quality or more nutritious product variants often rely on older, non-proprietary technology best suited for small-scale production; information about product quality is a key driver of demand at the retail level; and the largest producers have consistently made use of every tool available to influence food-related policies, attitudes, and perceptions (Smith, Chouinard, and Wandschneider, 2011).

In this article we develop a theoretical model that aims to capture this phenomenon. We consider a setting in which consumers engage in costly search in the presence of uncertainty regarding product quality. A single seller offers a low-quality good, while high-quality goods are competitively produced. The presence of search costs in the model creates a situation in which multiple equilibria exist, and equilibrium selection occurs as a function of the parameters of the consumer's search problem. We show that the seller of low-quality goods has incentive to engage in *promotion* (lowering the search cost for his own product), *obfuscation* (increasing the search cost for his competitors' products), *quality control* (increasing the expected quality of his own product), and *sabotage* (decreasing the expected quality of his competitors' products), all subject of course to political, technological, and legal constraints on achieving these objectives.

2 Theory

We begin with a consumer search setting consistent with the model introduced by Weitzman (1979). The consumer is faced with a choice of n products, one of which is of low quality (L) and the rest of which are of high quality (H). The consumer must pay search cost c_i in order to discover the true value of a good of type i, $i \in \{L, H\}$. Good L yields value x_L with probability p_L and zero with probability $(1 - p_L)$. We allow for heterogeneity in consumer preferences with respect to products of type H by assuming that consumers are distributed uniformly on the unit interval $l \in [0, 1]$, such that for consumer l a given type-H good yields value $x_H(l) = a + lb$ with probability p_H and zero with probability $(1 - p_H)$ where $b > 0$ and $l \in [0, 1]$ is the market share of the low-quality product.

In this setting, Weitzman (1979) shows that the consumer's decision as to which product to choose (i.e., for which product, if any, he will choose to pay the search cost in order to discover its true value) is determined entirely by his *reservation price*, defined as the maximum price he would be willing to pay for the privilege of choosing a given product, if no other (yet-to-be-searched) products were available. In particular, the consumer will choose the product with the highest reservation price.

Assuming that high-quality and low-quality producers are both viable, the equation

$$a + lb - \frac{c_H}{p_H} = x_L - \frac{c_L}{p_L} \geq 0 \tag{1}$$

specifying that the reservation prices for both types of product are the same, has a solution $l^* \in (0, 1)$. We assume that the reservation price of the marginal consumer l^* determines the equilibrium price of the products. Then

$$l^* = \frac{1}{b}\left(x_L - a + \frac{c_H}{p_H} - \frac{c_L}{p_L}\right). \tag{2}$$

And (neglecting production costs),[1] the low-quality producer's profit function is given by

$$\pi_L = \frac{1}{b}\left(x_L - a + \frac{c_H}{p_H} - \frac{c_L}{p_L}\right)\left(x_L - \frac{c_L}{p_L}\right)$$

[1] Given that we have assumed viability, production cost will only come into play at the margin when market share is affected. This assumption is thus qualitatively equivalent to assuming constant marginal cost.

Note that in equilibrium, profit is a function of the (exogenously given) parameters of the search model. This allows us to investigate the implications of the introduction of technology that allows the low-quality producer (henceforth "L") to alter these parameters.

2.1 Equilibrium Selection

Suppose, first of all, that L seeks to maximize profit and is able to costlessly manipulate the parameters of the model. In which direction would he choose to move them? It is easy to show that in each case the marginal effect on profit is unambiguous, with $\frac{\partial \pi_L}{\partial c_L} < 0$, $\frac{\partial \pi_L}{\partial c_H} > 0$, $\frac{\partial \pi_L}{\partial x_L} > 0$, $\frac{\partial \pi_L}{\partial a} < 0$, $\frac{\partial \pi_L}{\partial b} < 0$, $\frac{\partial \pi_L}{\partial p_L} > 0$, and $\frac{\partial \pi_L}{\partial p_H} < 0$. The strictly positive marginal profits in each case imply that L would pay to alter each parameter accordingly, assuming sufficiently cost-effective technology were available, and legal barriers did not stand in the way. We briefly discuss the implications of each below.

2.1.1 Promotion

First, L can increase profits at the margin by decreasing c_L, the search cost faced by a consumer considering whether to purchase his product. Consider, for example, the problem faced by early producers of processed infant foods, circa 1900. Initially, few mothers would have even been aware of the existence of commercial alternatives to breastfeeding, and acquiring the knowledge necessary to be confident feeding such seemingly foreign substances to one's baby would have seemed a daunting task to the ordinary housewife. Producers overcame this problem with aggressive promotion: advertisements in national magazines, free samples and educational pamphlets for first-time buyers, and detailed instructions on appropriate dosage provided to doctors in a position to "prescribe" the products to mothers. These actions can all be interpreted as lowering the (product class-specific) search costs consumers had to incur before deciding to make a purchase. The same can be said, of course, of the minimum-quality standard favored by the large canners in the 1938 legislation.

2.1.2 Obfuscation

When it comes to the high-quality competition, however, our model suggests L should take the opposite view. Search cost c_H can be increased (or maintained at high levels) by L via active opposition to informative and credible third-party verification systems (as in the proposed grades for canned goods in the 1930s). But the absence of substantive oppositional promotion (i.e., costly actions that might serve to lower c_H) from the atomistic H-type producers is also likely to be important in determining equilibrium search costs.

2.1.3 Quality Control

It is unsurprising that L will benefit from higher perceived quality (x_L) and a better probability of satisfying his customers once they have made a purchase (p_L). In practice, such efforts have historically emphasized the most easily observable characteristics of food products, such as taste and the propensity to cause short-term illnesses such as food poisoning. Public concern about hygiene in industrial food preparation, for example, prompted industry leader Heinz to sponsor an ad campaign in 1906 proclaiming its mincemeat to be "the exemplification of purity" because it was prepared "by neat uniformed workers" in "model kitchens" that were always open to visitors. It has also been suggested that mass-marketed food products often appear to be designed (e.g., mildly seasoned, with industry-standard levels of salt, sugar, and caloric density) to satisfy the broadest possible spectrum of customer tastes (Smith, 2004); this practice could be interpreted as an attempt to maximize the parameter p_L.

2.1.4 Sabotage

Influencing the competition's quality parameters (x_H and p_H) might be difficult to accomplish directly. But it is undoubtedly true that intervention in the regulatory process (e.g., by lobbying against quality standards or traceability requirements in order to foment a collapse of quality competition) can affect equilibrium levels of quality provided in the marketplace. While we do not model this process directly, our results do provide some motivation for the posturing observed in historical debates such as that involving the canning industry of the 1930s. There have also, of course, been many instances in the history of the food industry in which particular ad campaigns attempted to specifically denigrate as "inferior" traditional products such brown sugar, whole grain flour, and raw milk.

2.2 Linear-quadratic case

In this subsection and the next we present some preliminary results on the existence of equilibria when the monopolist chooses the various parameters discussed above.

2.2.1 Manipulating opponent's search costs

Now assume that a, b, c_L, p_H, and p_L are given, while the low-quality producer can manipulate c_H. Let the manipulated value be $c_H + d_H$. Assuming quadratic manipulation costs, the low-quality producer's profit function then equals

$$\pi_L(d_H) = \frac{1}{b}\left(x_L - a + \frac{c_H + d_H}{p_H} - \frac{c_L}{p_L}\right)\left(x_L - \frac{c_L}{p_L}\right) - \alpha d_H^2,$$

resulting in

$$d_H = \frac{x_L - \frac{c_L}{p_L}}{2\alpha p_H b}.$$

Turning to social welfare, a change in d_H, and thus in l^*, does not change the total revenue of the two types of firms. However, it influences consumer surplus, which equals

$$\frac{1}{2}\left[(a+b) - \left(x_L - \frac{c_L}{p_L}\right)\right](1 - l^*),$$

where l^* is increasing in d_H, and therefore, consumer surplus decreases in d_H.

2.2.2 Manipulating own search costs

Next we turn to the case in which the monopolist manipulates its own search cost c_L by d_L. We still assume that the marginal consumer, and thus, market share is determined by

(2), in which now c_L has to be replaced with $c_L + d_L$. Hence, the low-quality producer's profit function is given by

$$\pi_L(d_L) = \frac{1}{b}\left(x_L - a + \frac{c_H}{p_H} - \frac{c_L + d_L}{p_L}\right)\left(x_L - \frac{c_L + d_L}{p_L}\right) - \alpha d_L^2.$$

The first-order condition equals

$$\pi_L'(d_L) = -\frac{1}{bp_L}\left(\frac{c_H}{p_H} - a + 2\left(x_L - \frac{c_L + d_L}{p_L}\right)\right) - 2\alpha d_L = 0.$$

Assuming an interior solution, we obtain

$$d_L = -\frac{\left(\frac{c_H}{p_H} - a\right) + 2\left(x_L - \frac{c_L}{p_L}\right)}{2\left(\alpha p_L b - \frac{1}{p_L}\right)}.$$

Observe that the above numerator is positive since we assumed that $l^* \in (0,1)$ and $x_L - \frac{c_L}{p_L} \geq 0$. The denominator can be shown to be strictly positive by the second-order conditions for profit maximization ($\pi_L''(d_L) < 0$). Thus the monopolist will always invest in decreasing search costs for his own product.

2.2.3 Manipulating quality

Assuming that high-quality and low-quality producers are both viable, equation (1) remains still valid and l^* can be determined in the same way. Now we assume that a, b, c_L, c_H, p_H, p_L are given, while the low-quality producer can manipulate x_L. Let the manipulated value be $x_L + y_L$. Then the low-quality producer's profit function equals

$$\pi_L(y_L) = \frac{1}{b}\left(x_L + y_L - a + \frac{c_H}{p_H} - \frac{c_L}{p_L}\right)\left(x_L + y_L - \frac{c_L}{p_L}\right) - \beta y_L^2,$$

resulting in

$$2y_L\left(\frac{1}{b} - \beta\right) = 2x_L - \frac{c_L}{p_L} - a + \frac{c_H}{p_H}.$$

Now the monopolist increases or decreases its quality depending whether $\left(\frac{1}{b} - \beta\right)$ is positive or negative.

2.2.4 Manipulating quality (in case of an increasing cost function)

Assuming that high-quality and low-quality producers are both viable, equation (1) remains still valid and l^* can be determined in the same way. Now we assume that a, b, c_L, c_H, p_H, p_L are given, while the low-quality producer can manipulate x_L. Let the manipulated value be $x_L + y_L$. Then the low-quality producer's profit function equals

$$\pi_L(y_L) = \frac{1}{b}\left(x_L + y_L - a + \frac{c_H}{p_H} - \frac{c_L}{p_L}\right)\left(x_L + y_L - \frac{c_L}{p_L}\right) - \left(y_L^2 - 2y_L\right),$$

resulting in

$$y_L \cdot 2b\left(1 - \frac{1}{b}\right) = 2\left(x_L - \frac{c_L}{p_L}\right) + \frac{c_H}{p_H} - a.$$

Now the monopolist increases or decreases its quality depending whether $\left(1 - \frac{1}{b}\right)$ is positive or negative.

2.3 Convex case

Assume that $x_H(\cdot)$ is strictly increasing and convex. Moreover, manipulating the search cost of the high-quality firms is a strictly convex function of d_H with a minimum at $d_H = 0$. Now equation (1) takes the following form:

$$x_H(l) - \frac{c_H}{p_H} = x_L - \frac{c_L}{p_L} \geq 0,$$

from which one obtains

$$l^* = x_H^{(-1)}\left(\frac{c_H}{p_H} + x_L - \frac{c_L}{p_L}\right).$$

Let us denote the inverse function of $x_H(\cdot)$ by $z_H(\cdot)$ and let $[\gamma, \delta] = x_H([0,1])$ the image of x_H. Then z_H is strictly increasing and strictly concave. In addition, $z_H(\gamma) = 0$ and $z_H'(\gamma) > 0$. The monopolist's profit function equals

$$\pi_L(d_H) = z_H\left(\frac{c_H + d_H}{p_H} + x_L - \frac{c_L}{p_L}\right)\left(x_L - \frac{c_L}{p_L}\right) - c(d_H).$$

Supposed that we have an interior solution, the first order condition

$$\pi_L'(d_H) = \frac{1}{p_H} z_H'\left(\frac{c_H + d_H}{p_H} + x_L - \frac{c_L}{p_L}\right)\left(x_L - \frac{c_L}{p_L}\right) - c'(d_H) = 0$$

determines the optimal level of manipulation. Since z_H' is strictly positive and c' is strictly negative for negative d_H a solution of the first order condition must be positive, i.e. $d_H^* > 0$. Hence, increasing the competitive firm's search cost is beneficial for the monopolist.

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