Cynthia A. Montgomery
Harvard University

Birger Wernerfelt
Massachusetts Institute of Technology

Risk Reduction and Umbrella Branding*

In the context of competitive markets with asymmetric information, we develop a model of firms' branding decisions. In equilibrium, both branded and unbranded products exist, and we characterize price-quality relationships between them. In contrast to other advertising models, we predict that branded products will have *lower* average (price-adjusted) quality than unbranded products. This lower average is counterbalanced by lower variance in product quality, giving branding a risk-reducing rather than a quality-guaranteeing function. We describe industries in which these relationships are likely to be stronger and test the predictions using *Consumer Reports* data on quality and price.

I. Introduction

Despite the fact that branding is a very common and resource-consuming practice, there are few theories about its economic functions. The bulk of extant theory (Klein and Leffler 1981; Milgrom and Roberts 1986; Wernerfelt 1988) looks at branding as a guarantee of quality. A problem with these theories is that they do not explain the simultaneous existence of branded and unbranded products.[1] We here extend the model of Klein and Leffler (1981) by allowing consumers to be asymmetrically informed. In such a model, both types of products exist, and, in direct contrast to the existing literature, branded products will have lower average quality than unbranded products. However, this lower average is counterbalanced by a lower variance in quality. In a further development of the model, we allow firms to offer several products. By using the same brand name on these products, a practice herein called umbrella branding, firms post repeat

* Comments from an anonymous referee, Tim Bollerslev, Peter Pashigian, and seminar audiences at Carnegie-Mellon, Cornell, Stanford, and the University of Texas are gratefully acknowledged. We thank Robert Sartain for commendable research assistance. All errors are ours.

1. Wiggins and Lane (1983) is an exception to this, but their model has the unfortunate property that prices are exogenous.

(*Journal of Business*, 1992, vol. 65, no. 1)

0021-9398/92/6501-0002$01.50

purchases of all products as bonds for the quality of each product. In this context, umbrella branding lowers the cost of risk reduction.

The article is organized as follows. In Section II we present the theory outlined above and describe equilibrium price-quality relationships. In particular, we demonstrate the risk-reduction effect of umbrella branding and show that this effect will be stronger in markets with higher prices. In the remainder of the article we test these results on a sample of 3,335 individual products. These data and the measures employed are described in Section III. In Section IV we present the results. Consistent with expectations, umbrella branded products are found to be low-value, low-risk offerings. Further, as expected, this risk-reduction effect is stronger for higher-priced products. We conclude with a discussion in Section V.

II. The Model

A unit mass of identical consumers each buys one unit of a product in periods $t = 1, 2, \ldots$. They have income, y, which can be spent on the product in question, and a numeraire good, z. It is not possible to transfer products between periods. If a product of quality q sells for price $p(q)$, we can substitute the budget constraint into the utility function $U(z, q)$ to get the partially indirect utility function $W(p, q) \equiv U(y - p, q)$. Under standard assumptions, W is decreasing in p, increasing in q, and concave in both arguments. The product is to some extent an experience good (Nelson 1970), such that only a fraction, α, of the consumers can tell quality on sight. The remaining $1 - \alpha$ consumers must rely on price signals to evaluate current quality, although they will learn about past quality by word of mouth. All consumers know the structure of the game.

There is free entry in each period, and a measure n firms choose to participate by selecting a quality level and posting prices. Prices and qualities can be changed each period. In the period before each entry, these firms incur a one-time sunk cost s, and after entry they face average salvageable costs $c(x, q) \equiv C_1(q)/x + C_2(x)$, where x is quantity sold. We assume that c is U-shaped in x and increasing and convex in q. For a given interest rate $r > 0$, we can define $\underline{c}(q) \equiv \min_x[c(x, q) + sr/x]$. We assume that $\underline{c}$ is increasing and convex.

A. Full Information

Suppose first that $\alpha = 1$. That is, all consumers can tell quality on sight.

Claim 1. In equilibrium, n^* firms produce a price, quality, quantity triple p^*, q^*, x^* such that

$$p^* = \underline{c}(q^*) \tag{1}$$

(zero profits),

$$-[\partial W(p^*, q^*)/\partial q]/[\partial W(p^*, q^*)/\partial p] = d\,\underline{c}(q^*)/dq \tag{2}$$

(the marginal value of quality equals its marginal cost), and

$$n^*x^* = 1 \tag{3}$$

(all demand is met—recall that demand is standardized to unity).

We take the liberty of omitting a proof.

B. Asymmetric Information

The more interesting situation occurs when $\alpha \in [0, 1)$. Suppose that prior to purchase the $1 - \alpha$ uninformed consumers can identify whether current quality is below $\underline{q}$ or not but cannot make further distinctions. In addition, let us allow the firms to spend amounts b on conspicuous expenditure, such as advertising, in the period before entry. All consumers observe these expenditures as well as the past qualities of each firm. We finally assume that the out-of-equilibrium beliefs are that any price or any b, different from those in equilibrium, signals that current quality is $\underline{q}$.

As illustrated in figure 1 below, four types of strategies thus need to be considered: (*a*) n^* firms that offer (p^*, q^*) and sell at least to the informed; (*b*) $\underline{n}$ firms that offer $\underline{q}$ at $p \equiv c(q)$, such that the uninformed can eliminate all risk; (*c*) $n°$ firms that will offer $\underline{q}$ at p^*, hoping to rip off the uninformed who gamble by buying at p^*; and (*d*) $\overline{n}$ firms that will pursue the solution offered by Klein and Leffler: sink $\overline{b}$ into conspicuous consumption and then offer $(\overline{p}, \overline{q})$ where $\overline{p}$, $\overline{q}$, and $\overline{b}$ are given by

$$\overline{p} = c(\overline{x}, \overline{q}) + r(s + \overline{b})/\overline{x} \tag{4}$$

(zero profits—this is eq. [7] in Klein and Leffler 1981);

$$\overline{x} = \mathrm{argmin}_x[c(x, \overline{q}) + r(s + \overline{b})/x] \tag{5}$$

(minimum average costs);

$$[\overline{p} - c(\overline{x}, \underline{q})]\overline{x}/(1 + r) = s + \overline{b} \tag{6}$$

(no cheating—if a firm cheats without changing price, it will sell $\overline{x}$; if it changes price, we assume that consumers infer a low quality); and

$$-[\partial W(\overline{p}, \overline{q})/\partial q]/[\partial W(\overline{p}, \overline{q})/\partial p] = d\min_x[c(x, \overline{q}) + r(\overline{b} + s)/x]/dq \tag{7}$$

(the marginal value of quality equals its total marginal costs).

Since all consumers are identical, the uninformed will prefer $(\overline{p}, \overline{c})$ over $(\underline{p}, \underline{q})$ if $\overline{W} \equiv \overline{W}(\overline{p}, \overline{q}) > W(\underline{p}, \underline{q})$. To make the model interesting, we will assume that this is the case. We further define $W^* \equiv W(p^*, q^*)$ and $W° \equiv W(p^*, \underline{q})$.

Our final assumption has to do with the rip-off strategy $(p^*, \underline{q})$. Firms following this strategy will be penalized by the consumers such that they will find it profitable to produce in only 1 period. In order for this strategy to be individually rational, there has to exist a sales volume such that these firms can recoup their entry cost (plus interest) in 1 period. That is, it is necessary that

$$\max_x [p^* - c(x, \underline{q})]x \geq s(1 + r). \tag{8}$$

If (8) is violated, the $(p^*, \underline{q})$ strategy is not viable and all sales at p^* will be for q^*. Consequently, the demand for $(\overline{p}, \overline{q})$ will disappear also. To focus on the case where branding occurs, we therefore assume that (8) holds. Further, we define x° as the smallest quantity

$$(1 + r)s = [p^* - c(x^\circ, \underline{q})]x^\circ. \tag{9}$$

We can now prove the following.

CLAIM 2. The strategies described below constitute an equilibrium.
If

$$\alpha < \frac{(x^* - x^\circ)(\overline{W} - W^\circ)}{x^\circ(W^* - W^\circ) + (x^* - x^\circ)(\overline{W} - W^\circ)}, \tag{a}$$

then a fraction, $1 - \upsilon$, of the uninformed buy at $\overline{p}$, where

$$\upsilon = \frac{\alpha x^\circ(W^* - W^\circ)}{(1 - \alpha)(x^* - x^\circ)(\overline{W} - W^\circ)}.$$

All other consumers buy at p^*, where

$$\overline{n} = \frac{[(1 - \alpha)(x^* - x^\circ)(\overline{W} - W^\circ) - \alpha x^\circ(W^* - W^\circ)]}{\overline{x}(x^* - x^\circ)(\overline{W} - W^\circ)},$$

$$n^* = \alpha(x^* - x^\circ),$$

and

$$n^\circ = \frac{\alpha(W^* - \overline{W})}{(x^* - x^\circ)(\overline{W} - W^\circ)}.$$

The $(\overline{p}, \overline{q})$ firms remain the same each period, while the $(p^*, \underline{q})$ firms exit after 1 period. At the beginning of each period, n° firms enter, and these, together with the n^* firms who offered (p^*, q^*) last period, randomize between offering $(p^*, \underline{q})$ and (p^*, q^*) for the new period.

If

$$\frac{x^* - x^\circ}{x^*} > \alpha \geq \frac{(x^* - x^\circ)(\overline{W} - W^\circ)}{x^\circ(W^* - W^\circ) + (x^* - x^\circ)(\overline{W} - W^\circ)}, \tag{b}$$

then all consumers buy at p^*, where

$$\overline{n} = 0,$$

$$n^* = \alpha/(x^* - x^\circ),$$

and

$$n^\circ = \frac{(1 - \alpha)x^* - x^\circ}{(x^* - x^\circ)x^\circ}.$$

The $(p^*, \underline{q})$ firms exit after 1 period, and n° new entrants replace them. At the beginning of each period, the new entrants and the incumbents randomize between offering $(p^*, \underline{q})$ and (p^*, q^*) for the new period.

If

$$\alpha \geq (x^* - x^\circ)/x^*, \tag{c}$$

then all trade takes place at (p^*, q^*), and the firms are infinitely lived.

Proof. For free-entry equilibrium we need (1) zero profit, (2) profit maximization, (3) consumer maximization, and (4) fulfilled demand at each price-quantity pair.

1. This is assured by the definitions of the (p, q, x, b) vectors.
2. Deviations in p or b are inoptimal by the postulated beliefs. Deviations in q are not an issue for $(p^*, \underline{q})$ firms. For (p^*, q^*) firms, such deviations merely change them to $(p^*, \underline{q})$ firms. Finally, (6) checks the temptation to cheat for $(\overline{p}, \overline{q})$ firms.

Consider finally the randomization rules. If a firm offers $(p^*, \underline{q})$, it receives a one-time cash flow of s. If a firm offers (p^*, q^*), its period cash flow is rs, and it can opt to offer $(p^*, \underline{q})$ next period, giving it $(1 + r)s$. The net present value of this would be $rs + (1 + r)s(1 + r)^{-1} = (1 + r)s$, the same as the value of offering $(p^*, \underline{q})$ at once. So the firms are indeed indifferent between (p^*, q^*) and $(p^*, \underline{q})$. Note that this assumes that it is costless to change quality. We will discuss this assumption below.

3. Suppose that all three types of firms exist. Given the firm randomization, the only useful historical information is whether a firm spent b. To sustain consumer randomization, the uninformed have to be indifferent between $\overline{W}$ and a convex combination of W^* and W°. Thus, we need

$$\overline{W} = (n^*W^* + n^\circ W^\circ)(n^* + n^\circ)^{-1}. \tag{10}$$

4. Fulfilled demand at (p^*, q^*) means that

$$n^*x^* = \alpha + (1 - \alpha)\upsilon n^*(n^* + n^\circ)^{-1}. \tag{11}$$

At $(p^*, \underline{q})$ we need

$$n^\circ x^\circ = (1 - \alpha)\upsilon n^\circ(n^* + n^\circ)^{-1}. \tag{12}$$

And at $(\overline{p}, \overline{q})$ we need

$$\overline{nx} = (1 - \alpha)(1 - \upsilon). \tag{13}$$

By solving (10)–(13) for υ, $\bar{n}$, n^*, and n°, one gets (*a*) of the claim. At

$$\alpha = (x^* - x^\circ)(\overline{W} - W^\circ)/[x^\circ(W^* - W^\circ) + (x^* - x^\circ)(\overline{W} - W^\circ)],$$

$\upsilon = 1$, and we get (*b*). Note that we then only need

$$n^*x^* = \alpha + (1 - \alpha)n^*(n^* + n^\circ)^{-1} \tag{11'}$$

and

$$n^\circ x^\circ = (1 - \alpha)n^\circ(n^* + n^\circ)^{-1}. \tag{12'}$$

At $\alpha = (x^* - x^\circ)/x^*$, $n^\circ = 0$, and we have (*c*). Q.E.D.

Note that the equilibrium is well-behaved in the sense that it is a continuous function of α that specializes to the full-information outcome ($\bar{n} = n^\circ = 0$) or the Klein-Leffler (1981) outcome ($n^\circ = n^* = 0$) as $\alpha = 1$ or 0, respectively. Part (*a*) of the claim is illustrated in figure 1, where the location of x° reflects that the (p^*, $\underline{q}$) firms have to recoup their entry fee in 1 period.

To discuss the robustness of this equilibrium, we focus on two issues. First, the assumption that costs, $c(x, q)$, are independent across periods and, second, the homogeneity of preferences.

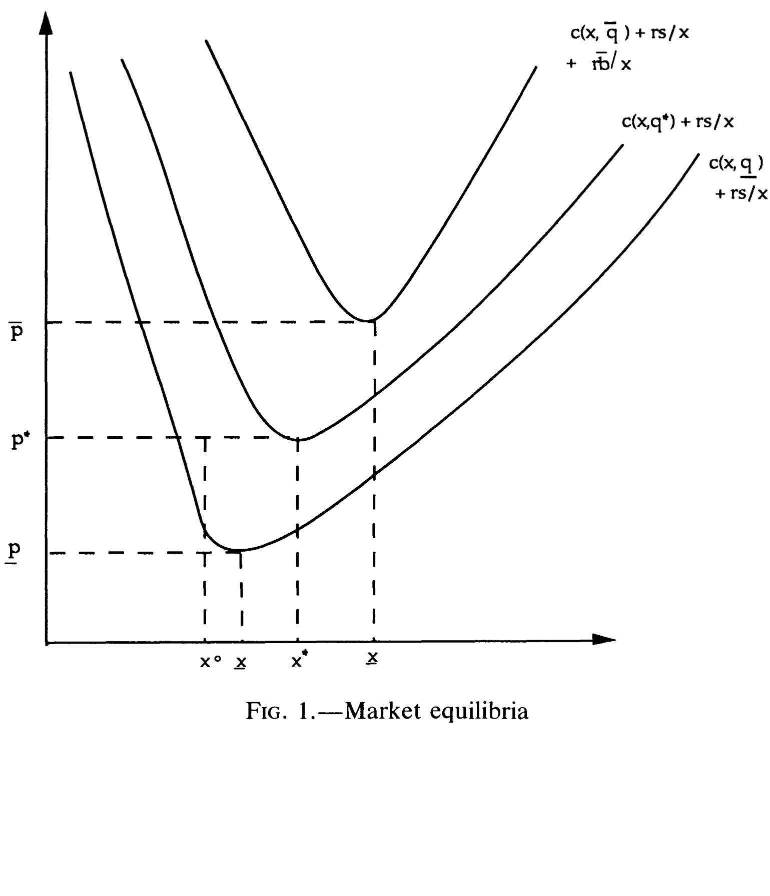

FIG. 1.—Market equilibria

The independence assumption is standard in Arrow-Debreu theory and has been used in most dynamic models of imperfect competition, including that of Klein and Leffler (1981). The usual defense invokes the presumption that "small" levels of dynamic interdependence would lead to "small" changes in equilibria. However, in mixed-strategy equilibria such as that presented above or by Varian (1980), things are especially complicated.

To analyze robustness, let us informally consider a simple example of intertemporal externalities. Specifically, assume that firms incur a fixed, positive cost δ every time they change their quality levels. This has two effects on equilibrium. First, the bond b, posted by the $(\bar{p}, \bar{q})$ firms, can be smaller. The reason is that the gains from cheating for a firm that has produced $\underline{q}$ earlier have been reduced by δ. (This argument does not apply in the first period, so there will be some nonstationarity in the payoffs.) Secondly, the uninformed customers can now distinguish between three types of firms: $(\bar{p}, \bar{q})$ firms, p^* firms who offered q^* last time, and new p^* firms. The last group of firms can offer $\underline{q}$ without incurring δ, so the volume sold by these firms should yield profits of rs from q^* and $(1 + r)s$ from $\underline{q}$. Similarly, the "old" firms should each sell enough to make $r(s + \delta)$ from q^* and $(1 + r)(s + \delta)$ from $\underline{c}$. To see that these returns would support randomization by the firms, compare the profits from (entry, $\underline{q}$) to those from (entry, q^*, $\underline{q}$). In the former case, the firm makes $-s + (1 + r)s(1 + r)^{-1} = 0$, and in the latter case it makes

$$-s + rs(1 + r)^{-1} - \delta(1 + r)^{-1} + (1 + r)(s + \delta)(1 + r)^{-2} = 0.$$

So while intertemporal externalities change the equilibrium, they need not change it drastically, nor make it unravel.

Let us now assume that the firms each sell m different products to the same consumers.

C. *Multiproduct Firms*

We divide each period into m parts, using the notation (T, τ) for the τth part of the Tth period. The idea now is that the parties trade product 1 in part 1 of each period, product 2 in part 2, and so on. Information is here revealed after each part of each period, so a firm that supplies $\hat{q} \neq q^*$ or $\hat{q} \neq \bar{q}$ in any (T, τ) will bear the consequences from $(T, \tau + 1)$ on. Assuming that the preferences and the cost functions are identical across products, the analogues of (6) and (9) are

$$[\bar{p} - c(\bar{x}, \underline{q})]\bar{x}/(1 + r) = m(s + \bar{b}) \tag{14}$$

and

$$[p^* - c(x^\circ, \underline{q})]x^\circ/(1 + r) = ms. \tag{15}$$

Compared to the single-product case, these differ only because the right sides are multiplied by the number of products. Intuitively, the $(\bar{p}, \bar{q})$ firms post the sunk costs in all products as bonds to guarantee quality of each product. Similarly, the $(p^*, \underline{q})$ firms forgo future profits in all products in return for "cheating" profits in one product.[2] We claim without proof that the structure of equilibrium is the same as in section B.

A property of the equilibrium is that higher values of m make for cheaper quality assurance (14) and lower risk of ripoffs in the sense of (15). To see this, we first assume that the analog of (8) holds:

$$ms < \max_x[p^* - c(x, \underline{q})]x/(1 + r) \tag{8'}$$

such that the heterogeneous equilibrium exists. In this case the excess profits per product to the $(\bar{p}, \bar{q})$ firms are, by (4) and (14),

$$\bar{b} = [c(\bar{x}, \bar{q}) - c(\bar{x}, \underline{q})]\bar{x}[m + (m - 1)r]^{-1} - s.$$

So $\bar{b}$ is smaller for larger m.

D. Implications

We can derive three testable implications of the model.

PRICE PREMIUM HYPOTHESIS. The average relative price for branded products is higher than that for unbranded products.

Proof. Define the isoutility curves, $Q(p)$, by $W(p, q) =$ constant. Because of the assumptions on $U(\cdot)$, the isoutility curves $Q(p)$ are increasing and concave. Further, lower curves have steeper slopes. So if $Q^*(p)$ and $\bar{Q}(p)$ correspond to W^* and $\bar{W}$, respectively, then $dQ^*/dp < d\bar{Q}/dp$ (see fig. 2).

Since the net cost of signaling is positive (counting q and b), the right-hand side of (7) is larger than that of (2). This implies that $dQ^*(p^*)/dp > d\bar{Q}(\bar{p})/dp$, so $\bar{p} > p^*$. Q.E.D.

RISK-REDUCTION HYPOTHESIS. Branded products have lower mean value and lower variance in value than unbranded products.

Proof. Since the variance result is trivial, we concentrate on showing

$$\frac{\bar{q}}{\bar{p}} < \frac{n^*q^*}{(n^* + n^\circ)p^*} + \frac{n^\circ}{(n^* + n^\circ)}\frac{\underline{q}}{p^*}. \tag{16}$$

Given that $\bar{p} > p^*$, (16) will hold if $d\bar{Q}(\bar{p})/dq < \bar{q}/\bar{p}$. The latter inequality in turn follows from the concavity of $\bar{Q}$. Q.E.D.

According to this hypothesis, the role of branding is to reduce the risk of getting "lemons." This is illustrated in figure 3.

The inequality (16) is in direct contradiction to the existing literature on branding and advertising (e.g., Klein and Leffler 1981; Milgrom and

2. Sullivan (1990) has measured effects of this type.

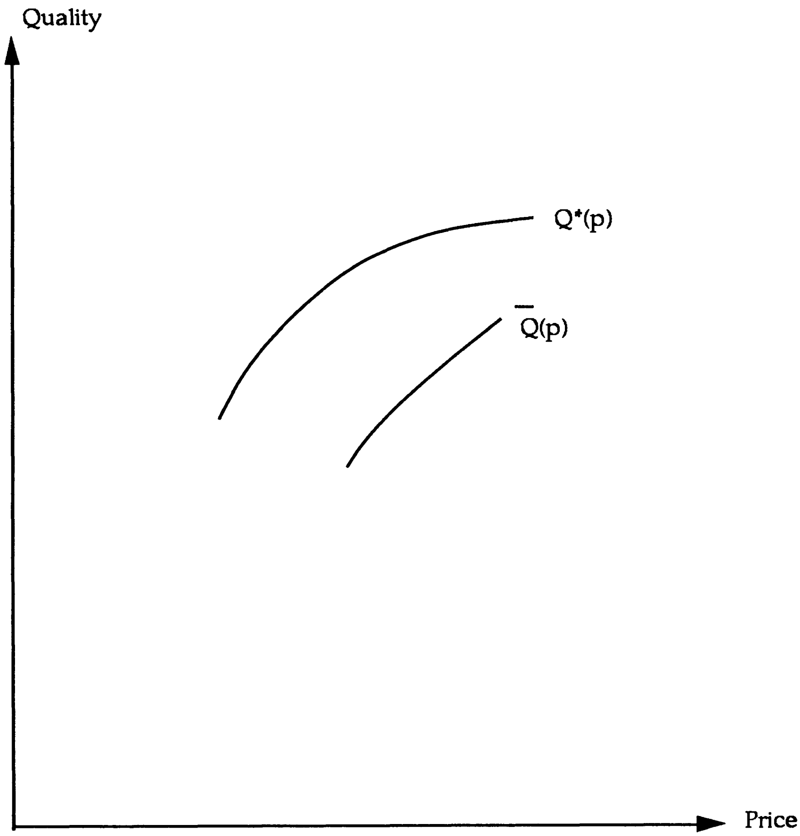

FIG. 2.—Isoutility curves

Roberts 1986; Wernerfelt 1988). It predicts a *lower* average (price-adjusted) quality of branded products. In further contrast to the existing literature, our model allows branded and unbranded products to coexist in equilibrium, even when tastes are homogeneous.

Assuming that the production function and the information structure is unaffected by unit price gives us the following.

PRICE EFFECTS HYPOTHESIS. The expected value discount for branded products goes up with industry price level.

Proof. Assume that (*a*) holds such that branded products exist. We can then write (16) as

$$\left(\frac{\overline{W} - W^{\circ}}{W^* - W^{\circ}}\right)\frac{q^*}{p^*} + \left(\frac{W^* - \overline{W}}{W^* - W^{\circ}}\right)\frac{\underline{q}}{p^*} - \frac{\overline{q}}{\overline{p}} > 0. \tag{17}$$

Since the hypothesis involves varying product category prices, the question is how increasing price levels deform C and U. There is no

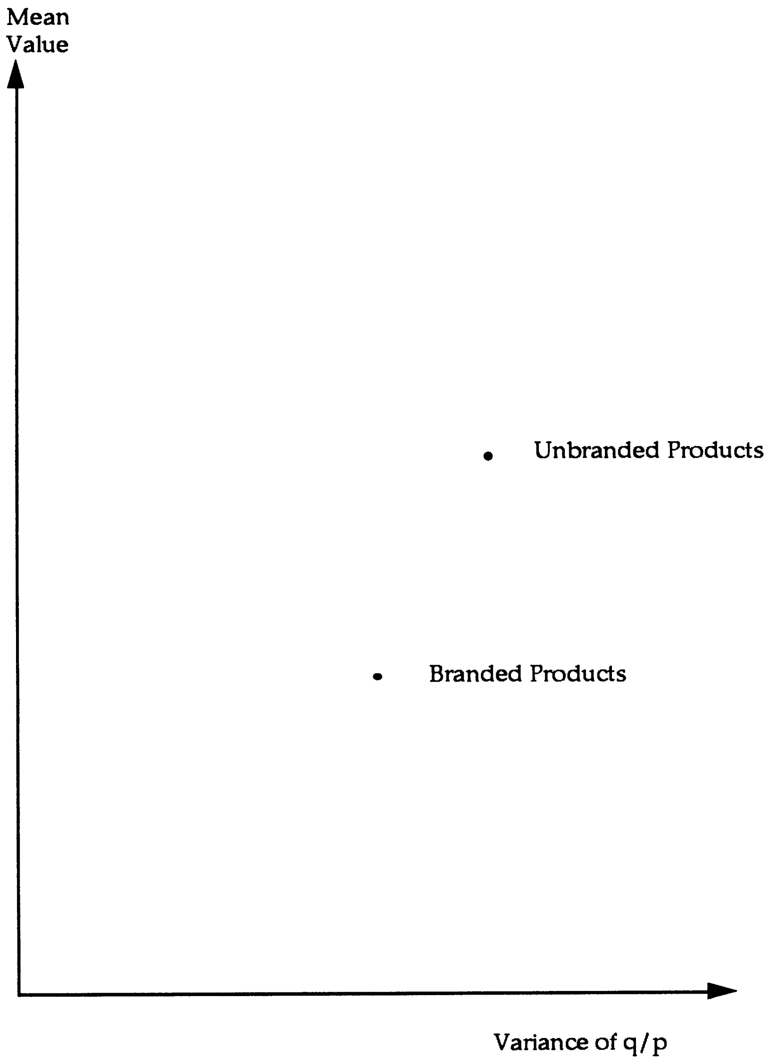

FIG. 3.—Mean value and variance of q/p

reason to believe that the production function or the information structure should vary systematically with unit price, while we have endowed U with risk aversion. To compare across two categories, normalize such that q^*/p^* and W^* are the same in both. Given risk aversion, the higher-priced category will have a lower W°, a lower $\overline{q}/\overline{p}$ (by eq. [7]), and a lower $\overline{W}$. Now denote the left-hand side of (17) by L. Clearly $\partial L/\partial(\overline{q}/\overline{p}) < 0$. By equation (10) and claim 2, we can find the change in $\overline{W}$ as a fraction $(W^* - \overline{W})(W^* - W^\circ)^{-1}$ of the change in $W°$. By direct computation, $\partial L/\partial W° + (W^* - \overline{W})(W^* - W°)^{-1}\partial L/\partial\overline{W} = 0$. So the net effect of high prices is to increase L. Q.E.D.

III. Data and Measures

A. Data

To test our hypothesis we needed objective quality and price measures on a large sample of products. *Consumer Reports,* published by the Consumers Union, is a unique source of such data. For this study we used their 1972 and 1977 *Buying Guides*. These issues provided data on 3,335 individual products. For each product, we recorded its price, its quality rank within its product category (industry), its brand name, and the name of its parent corporation.

To attest to the integrity of the data, it should be noted that Consumers Union is an independent, nonprofit organization, which is not allied with any firm whose products it evaluates. The ratings themselves are based on laboratory-test, controlled-use experiments, and/or expert judgments of purchased samples and are generally regarded to be of high quality (Thorelli and Thorelli 1977).

As in our model, Consumers Union assumes homogeneous tastes and publishes unidimensional quality measures. While this procedure involves a loss of information, it can be defended on several grounds. First, product categories are defined quite narrowly. For example, canister and upright vacuum cleaners are evaluated separately. Second, in a survey of 385 studies, Curry and Faulds (1986) showed that overall quality rankings are insensitive to weights given to individual product dimensions. This result is due to the fact that scores on individual dimensions tend to be positively correlated. Third, unidimensional measures of quality permit comparisons across product categories. Fourth, our theory assumes homogeneous utility functions. However, having noted these points, noise will be introduced into the data to the extent that real tastes are heterogeneous or poorly approximated by the *Consumer Reports* rankings.

Two additional properties of the data deserve mention. The intent of *Consumer Reports* is to meet demand for product information. Hence the product categories are not chosen randomly. In particular, inexpensive, nondurable search goods, while not missing from the data, are underrepresented. Further, the prices quoted in most product categories are manufacturers' recommended list prices (transaction prices are given in a few grocery categories). If markups, coupons, and sales differ across products, additional noise will be introduced. On balance, however, given the large sample size, these issues are unlikely to cause serious problems.

B. Measures

Within the theory, a branded product is one that has been tied to some level of conspicuous expenditure, such as advertising. The theory further suggests that there are economies of scope in branding such that all brand names should be placed on several products. However, due to factors not included in this model, for example, problems with the transferability of a particular brand name, or issues relating to the scope of the firm, we do not always observe multiple-product branding.

In practice, branding represents a continuum, on one end bounded by products that lack any kind of credible support, and on the other end bounded by products with extensive commitments, often made through long periods of time and shared across multiple products. Therefore, to distinguish between "branded" and "unbranded" products is very difficult. Given the impossibility of getting complete historical records of dedicated expenditure (e.g., the amount that has been spent in building the GE brand name), we elected to distinguish between branded and unbranded products based on the use of shared names. That is, we are implicitly assuming that there is a relationship between the size of the bond posted and its association with multiple products. Although this is not a perfect correlation, there should be a reasonable correspondence between the two.

A key operationalization in the study, then, is the measure of multiple branding, herein called umbrella branding. Following the theory, we need to identify products that are sold to the same group of consumers (or, more generally, to the group of people to whom these consumers talk). This should exclude some instances of shared names; however, in practice, how much to exclude is a difficult question. It seems fair to include instances where a brand name is used on several products within the same product category (Sappington and Wernerfelt 1985). In contrast, the extent to which the theory applies across product categories would seem to depend on the relationship among individual categories. For example, bicycle locks and bicycles appear to be a logical fit, as do sleeping bags and tents. However, one would guess that women's clothing and battery chargers rarely are bought by the same people.

In order to develop a robust analysis of these issues, we decided to use three hierarchical measures of umbrella branding. Our narrow measure, UB0, admits only shared names if they are used both within the same product category and in other product categories as well. Our medium measure, UB1, admits all shared names used within the same product category. (So UB1 captures all "line-extensions".) Finally, our broad measure, UB2, admits all shared names within the sample. That is, UB2 admits names if they are shared within or across product categories. So the set of products for which UB0 is one is a subset of the set for which UB1 is one, and the latter is again a subset of the set of products for which UB2 is one. Within individual product categories, sample representation is reasonably complete. For example, the 1977 Buying Guide lists 7 types of bicycle locks, with 22, 13, 6, 9, 11, 14, and 9 products of each type. We can thus be confident that we have a reliable measure of umbrella branding within categories.[3] However, given the fact that *all* consumer products are not in the sample, umbrella branding will be underestimated when a firm has more than one product sharing a brand name but has only one product in the sample. For this reason, we prefer the middle measure in our hierarchy, UB1.

The following variables were constructed for all products. Let t denote a product and i its product category.

$\mathrm{UB0}_t$ = narrow dummy for umbrella branding, set equal to one if the firm uses the same name on at least one other product in the same product category and at least one other product in another product category. Otherwise it is set equal to zero. Of the 3,335 products, 1,248 (37%) were umbrella branded in this sense.

$\mathrm{UB1}_t$ = medium dummy for umbrella branding, set equal to one if the firm uses the same name on at least one other product in the same product category. Otherwise it is set equal to zero. It should be noted that UB1 contains UB0, in that whenever UB0 is set equal to one, UB1 will also be set to one. Of the 3,335 products, 2,223 (67%) were umbrella branded in this sense.

$\mathrm{UB2}_t$ = broad dummy for umbrella branding, set equal to one if the firm uses the same name on at least one other product in any product category. Otherwise it is set equal to zero. It should be noted that UB2 contains UB1, in that whenever UB1 is set to one, UB2 will also be set to one. Of the 3,335 products, 2,775 (83%) were umbrella branded in this sense.

Q_t = relative quality of t in its product category. If products are ranked in groups with $g_1, g_2, \ldots, g_n$ members and t is in group j, then

$$Q_t = 1 - \left(\sum_{k=1}^{j-1} g_k + [g_j - 1]/2\right) \Big/ \sum_{k=1}^{n} g_k.$$

3. Within-category umbrella branding will be underrepresented to the extent that small-volume regional products are not included and to the extent that an umbrella identifier, different from a product's brand name, is associated with a product.

P_t = relative price of t in its product category. If there are N_i firms in the category, with prices $p_1, \ldots, p_t, \ldots, p_{N_i}$, then

$$P_t = p_t N_i \Big/ \sum_{k=1}^{N_i} p_k.$$

V_t = value of t. It is set equal to Q_t/P_t.

$\hat{p}_t$ = average price in t's product category i. It is defined as

$$\hat{p}_t = \sum_{k=1}^{N_i} p_k/N_i.$$

ΔV = average value of branded products, minus average value of unbranded products.

$\Delta\sigma$ = standard deviation of V_t for branded products, minus standard deviation of V_t for unbranded products.

ΔP = average relative price of branded products, minus average relative price of unbranded products.

The data are described in table 1.

The price premium hypothesis predicts that ΔP is positive.

The risk-reduction hypothesis, that values of branded products haver lower mean and variance than values of unbranded products, predicts that ΔV and $\Delta\sigma$ are negative.

Moving to the price effects hypothesis, it is useful to recall that value is normalized between industries such that a larger value discount for branded products is reflected in a smaller (more negative) correlation between UB_t and V_t. We can therefore test the hypothesis, that branded products have a larger value discount in higher-priced product categories, through the regression

$$V_t = \beta_0 + \beta_1 \, UB_t\hat{p}_t + \beta_2 \, UB_t + \epsilon_t.$$

The price effects hypothesis predicts that β_1 will be less than zero.

The regression also provides an alternative test of the means component of the risk-reduction hypothesis, specifically that $\beta_2 + 62.4\,\beta_1 < 0$ (62.4 is the mean of $\hat{p}_t$).

TABLE 1 **Means Standard Deviations, and Intercorrelations for Variables**

Variables	Means	Standard Deviations	1	2	3	4
1. UB0	.37	.48				
2. UB1	.67	.47	.55			
3. UB2	.83	.37	.35	.64		
4. Value	.57	.48	.01	−.04	−.03	
5. Average price	62.37	106.69	−.08	−.13	−.02	−.07

NOTE.—N = 3,335.

The three tests described above are formulated at the product level. That is, each of our 3,335 products constitutes a data point. It is tempting to also test at the market level to see if the majority of the markets conform to the theory. There are two problems with this idea. First, we can only estimate ΔV and ΔP for approximately 100 markets ($\Delta\sigma$ for fewer). Secondly, since most of these estimates have very large variance, our sample would be small and noisy. The logical approach would be to weigh the data points according to their precision, a procedure that ultimately would lead back toward our product-level test.

IV. Results

The tests of the price premium hypothesis are reported in table 2. As can be seen, the results point exactly opposite the predicted direction, and quite strongly so.[4] We will come back and discuss this after reporting the other test results.

The aggregate results of our tests of the risk-reduction hypothesis are given in table 3. Not all means and standard deviations are significantly different in the expected directions, but four out of six results are significant, in particular those for the medium measure of umbrella branding (UB1). Collectively these results support the view that branding serves a risk-reducing function.

The regression analyses are reported in table 4. Two things are important. First, there is strong and consistent support for the price effects hypothesis, that the value discount for branded products is larger for higher prices. Second, as can be seen from the line labeled $\beta_2 + 62.4\ \beta_1$, the results for the risk-reduction hypothesis are in line with those in table 3. That is, the results are significant in the expected direction for UB1 and UB2.

Given that the data support only two of our three hypotheses, it is imperative to evaluate other explanations of the coexistence of branded and unbranded products. Note that heterogeneity in seller strategies (other than mixing) requires heterogeneous buyers. In the present model, buyers are informationally heterogeneous. Heterogeneity in preferences is the other vehicle for generating equilibria in which both branded and unbranded products exist. In such a model, brand signaling would follow the lines of the price signaling described by

4. An alternative cut at this may be to look at four classes of products. Those with no umbrella branding within or between categories, those with umbrella branding between categories but not within, those with umbrella branding within categories but not between, and those with umbrella branding both within and between. The average relative prices for these are 1.03, 1.025, 100, and .97, respectively. From a business perspective, we have a hard time understanding umbrella branding between categories but not within as a conscious strategy (552 products fall in this class), so we will stay with the hierarchical classification UB0, UB1, and UB2.

TABLE 2 Average Relative Prices

	UB0	UB1	UB2
Umbrella branded	.97	1.00	1.00
Not umbrella branded	1.02	1.01	1.03
t	−3.76	−1.06	−2.06
Sign	.00	.29	.04

Wolinsky (1983). In the present notation, some consumers would prefer the branded product ($\overline{p}$, $\overline{q}$), while others would buy the unbranded product ($\underline{p}$, $\underline{q}$). Such an equilibrium is consistent with the price premium hypothesis and the price effects hypothesis, but not with the risk-reduction hypothesis, nor with the results reported here.

However, a simple combination of the two models could explain the data. Assume that there is heterogeneity in both information and preferences, such that the informed customers place a higher premium on quality than the uninformed. This is a quite natural assumption because customers who care the most about quality should use more information sources (including any outside the model). Specifically, denote the indirect utility functions of the informed and uninformed

TABLE 3 Means and Standard Deviations in Product Value

	N	Mean Value	Standard Deviation
UB0:*			
Umbrella branded	1,248	.574	.362
Not umbrella branded	2,087	.560	.534
t		−.83	
F			2.17
Sign		.41	.00
UB1:†			
Umbrella branded	2,223	.552	.359
Not umbrella branded	1,112	.592	.651
t		2.29	
F			3.30
Sign		.02	.00
UB2:‡			
Umbrella branded	2,775	.558	.474
Not umbrella branded	560	.601	.491
t		1.93	
F			1.07
Sign		.05	.26

* UB0 is a dummy variable set equal to one when the brand name is used both on another product in the same category and on another product in another category.

† UB1 is a dummy variable set equal to one when the brand name is used on another product in the same category.

‡ UB2 is a dummy variable set equal to one when the brand name is used on another product in the same category or another product category.

TABLE 4 Regressions on Value

	UB0	UB1	UB2
Intercept	.560	.592	.601
	(53.7)	(41.5)	(29.9)
Umbrella branding × price	−.0004	−.0004	−.0003
	(−2.68)	(−3.27)	(−2.71)
Umbrella branding	.037	−.020	−.027
	(1.94)	(−1.09)	(−1.18)
$\beta_2 + 62.4\,\beta_1$	.011	−.044	−.043
	(.63)	(−2.50)	(−1.95)
$\overline{R}^2$	.0017	.0042	.0028

NOTE.—N = 3,335. t-statistics are in parentheses.

consumers V and W, respectively. We can still find $(\overline{p}, \overline{q})$ by (4)–(7), while (p^*, q^*) are given by (1), (3), and the analogue of (2):

$$-(\partial V(p^*, q^*)/\partial q)/(\partial V(p^*, q^*)/\partial p) = d\underline{c}(q^*)/dq. \tag{18}$$

This also gives (p^*, q^*), and we can describe the equilibrium as before. Suppose now that p^* from (18) is greater than $\overline{p}$. With this assumption, the results are consistent with the results in table 2. At the same time, the risk-reduction hypothesis and the price effects hypothesis would continue to hold. This is illustrated in figure 4.

In extensive conversations with colleagues, we have found that many expect the risk-reduction effect to be stronger when fewer consumers are informed and when purchase frequency is lower. The intuition behind this view appears to be that such circumstances would provide less market discipline and thus leave consumers worse off. Our theory, however, does not support this view. To look at the effect of α, the number of informed consumers, it is sufficient to note that (17) is independent of α. The effect of r, the inverse purchase frequency, is more difficult to assess. However, higher values of r will have two effects in (17): increase the p's (in particular, $\overline{p}$) and decrease the W's (in particular, $\overline{W}$). Without further assumptions on $c(\ )$ and $W(\ )$, it is not possible to predict the net effect.

To test these "predictions," we classified products into experience and search goods using Nelson's (1970) criterion.[5] We further divided the sample into durables and nondurables in order to get a proxy for purchase frequency. These classifications give us

E_t = dummy for an experience good. This is 1 if the product is an experience good, 0 otherwise. Fifty-four percent of the products were experience goods.

5. To do this, we used the nonmerchandise receipts from the 1977 *Census of Retail Trade*.

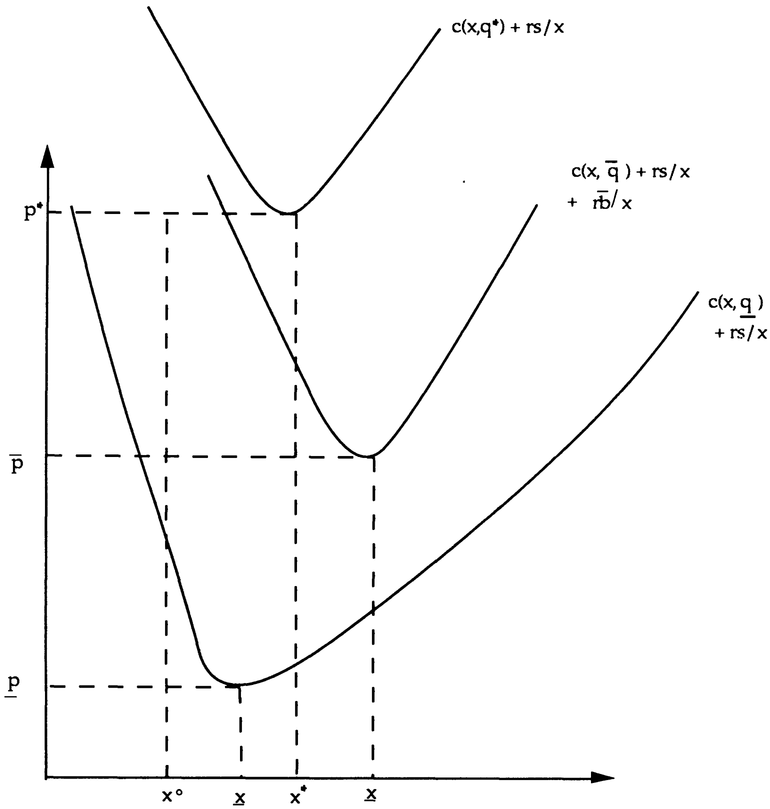

FIG. 4.—Heterogeneous tastes

D_t = dummy for durable good. This is 1 if the product is durable, 0 otherwise. Eighty percent of the products were durable.[6]

In table 5 we report regressions which control for the interaction terms $UB_t\ E_t$ and $UB_t\ D_t$. Consistent with the theory, the value discount for branded products is not influenced by E_t and D_t.

Another intuitive conjecture is that the quality variance of nonbranded products should decrease as the proportion of informed buyers increases. Unfortunately, the model does not unambiguously support this conjecture either. Consider case (*b*) of claim 2, in which value and quality are proportional. The ratio $n°/n^*$ is decreasing in α, but may be larger than one (if $\alpha < (x^* - x°)/(x^* + x°)$).

There is, however, some indirect evidence to support the conjecture.

6. The correlation between E_t and $\hat{p}_t$ is .31, and the correlation between D_t and $\hat{p}_t$ is .26. This level of correlation subsets suggests that multicollinearity is not a serious problem.

TABLE 5 **Regressions on Value with Control Variables**

	UB0	UB1	UB2
Intercept	.560	.592	.601
	(53.7)	(41.5)	(29.9)
Umbrella branding × experience	.036	.002	.024
	(1.16)	(.09)	(1.11)
Umbrella branding × durables	.001	−.009	−.006
	(.03)	(−.29)	(−.22)
Umbrella branding × price	−.0004	−.0004	−.0003
	(−2.80)	(−2.77)	(−2.71)
Umbrella branding	.024	−.014	−.032
	(.53)	(−.40)	(−.91)
$\overline{R}^2$	.0016	.0036	.0028

NOTE.—N = 3,335. t-statistics are in parentheses.

Specifically, Tellis and Wernerfelt (1987) show that the price quality correlation is larger in markets for unpackaged products. In our sample, table 6 compares the standard deviations in value for various types of unbranded products when $E_t = 1$ versus when $E_t = 0$. As can be seen, the results are roughly consistent with the conjecture.

Summarizing, the empirical results provide support for a model with heterogeneity in both preferences and information. Most important, the data are consistent with the view of branding as serving the function of risk reduction.

V. Conclusion

While previous literature looks at branding as a guarantee of quality, we developed and tested a theory portraying branding as a means of risk reduction. The empirical results are consistent with the theory, indicating that umbrella branding serves a risk-reducing function and that this effect is strongest when the product is expensive.

Two additional contributions are worth noting. First, our theory explains the simultaneous existence of branded and unbranded products. Second, we hope to have demonstrated the usefulness of a direct approach to the measurement of product quality. While such measures

TABLE 6 **Standard Deviations in Value**

	Unbranded			
	UB0	UB1	UB2	All
Experience good	.60 (1,258)	.74 (727)	.466 (352)	.536 (1,814)
Search good	.42 (829)	.45 (385)	.530 (208)	.395 (1,521)
F	2.07	2.69	1.29	1.85
Sign	.00	.00	.04	.00

NOTE.—N is in parentheses.

have a long history in the marketing literature, economists have traditionally preferred more indirect measures.

Concerning further research, it seems pertinent, but difficult, to look at the model in the context of oligopoly. Another potentially fruitful line of research would be to introduce some noise in consumers' product evaluations. Such an effect might reduce the incentives to apply an umbrella brand to an infinite number of products and give more appealing, intermediate, results.

In a broader perspective, our argument suggests the existence of reputational economies of scope. Since reputations are examples of productive factors that are difficult to trade in the open market (Montgomery and Wernerfelt 1988), they may provide a natural reason for the existence of multiproduct firms.

References

Curry, D. J., and Faulds, D. J. 1986. Indexing product quality: Issues, theory and results. *Journal of Consumer Research* 13 (September): 134–45.

Klein, B., and Leffler, K. 1981. The role of market forces in assuring contractual performance. *Journal of Political Economy* 89 (August): 615–41.

Milgrom, P., and Roberts, J. 1986. Price and advertising signals of new product quality. *Journal of Political Economy* 94 (August): 796–821.

Montgomery, C. A., and Wernerfelt, B. 1988. Diversification, Ricardian rents, and Tobin's q. *Rand Journal of Economics* 19 (Winter): 623–32.

Nelson, P. 1970. Information and consumer behavior. *Journal of Political Economy* 78 (March/April): 411–29.

Sappington, D., and Wernerfelt, B. 1985. To brand or not to brand? A theoretical and empirical question. *Journal of Business* 58 (July): 279–93.

Sullivan, M. 1990. Measuring image spillovers in umbrella-branded products. *Journal of Business* 63 (October): 309–29.

Tellis, G. J., and Wernerfelt, B. 1987. Competitive price and quality under asymmetric information. *Marketing Science* 6 (Summer): 240–53.

Thorelli, H. B., and Thorelli, S. V. 1977. *Consumer Information Systems and Consumer Policy*. Cambridge, Mass.: Ballinger.

U.S. Department of Commerce. 1977. *Census of Retail Trade*. Washington, D.C.: U.S. Government Printing Office.

Varian, H. R. 1980. A model of sales. *American Economic Review* 70 (September): 651–59.

Wernerfelt, B. 1988. Umbrella branding as a signal of new product quality: An example of signalling by posting a bond. *Rand Journal of Economics* 19 (Autumn): 458–66.

Wiggins, S. N., and Lane, W. J. 1983. Quality uncertainty, search, and advertising. *American Economic Review* 73 (December): 881–94.

Wolinsky, A. 1983. Prices as signals of product quality. *Review of Economic Studies* 50 (October): 647–58.