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THE IMPACT OF CORPORATE SIZE AND STRATEGY ON COMPETITIVE PRICING

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Larger firms are often hypothesized to have higher prices than smaller competitors because of their market power or implicit collusion on prices. Advertising is often suggested as another cause of price elevation due to its ability to differentiate products of equivalent or inferior quality. This study examines the effect of these and other factors on prices in the major home appliance industry. The most interesting result is the strong corporate effect on prices, which permeates pricing strategies across categories, models and time. Contrary to the hypotheses listed above, larger corporations have lower prices, and advertised products are not higher priced. Strategic and policy implications are discussed.

INTRODUCTION

Price is a key variable in strategy formulation, being the cost of the benefit that buyers must incur and the source of revenue for sellers. Because of this dual role, public policy-makers and managers have viewed pricing from different perspectives. The major focus of public policy-makers and economists has been to determine whether prices are 'fair' or whether consumers are obtaining value for money. In particular, one concern has been whether a market dominated by larger firms promotes higher prices due to shared market power among the large firms. Another concern has centered around whether higher-priced products do come with higher quality. Many researchers have theorized that, especially in consumer markets, advertising may have a stronger impact on price than product quality. Managerial concern has also centered on the same issues, but from a strategic perspective: Will expansion by product line extensions or acquisition of competitors' brands lead to higher or lower prices? Does it pay to provide better quality? Can advertising substitute for quality by commanding a higher price?

This paper analyses these issues in the context of the major home-appliance industry. Briefly, the paper seeks to determine what factors drive competitive prices in this industry. The paper presents a set of hypotheses about these determinants by integrating theory from the strategy, industrial organization economics and marketing literature. The literature suggests that firm size, product quality, advertising and branding are potentially major determinants of competitive price. However, there is no unanimity about which of these factors is most important, or even about the direction of their effects. A review of this literature, and an empirical investigation of the rival hypotheses, should therefore be enlightening.

The analysis could also be helpful to managers and public policy-makers. For example, whether larger share firms hold higher or lower prices has different implications for managerial policy on expansions and government policy on market concentration. The result may indicate whether the trend towards greater concentration in this industry presents a boon to competitors and a threat to consumers or vice-versa. Similarly, whether product quality or advertising has a

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bigger impact on competitive prices, and whether the impact of advertising is positive or negative leads to different conclusions about market behavior.

This study is primarily an empirical analysis of the determinants of competitive prices in the spirit of cross-sectional analyses of market share (e.g. Buzzell and Wiersema, 1981; Urban *et al.*, 1986). It involves an intra-industry analysis similar to studies by Hunt (1972) or Hatten, Schendel and Cooper (1978). Its focus on price variation complements the extensive research on the determinants of profit, while revealing new insights on the role of corporate size and strategy. For this study the data have been specifically assembled from various public sources. In the subsequent sections we review the literature, develop the hypotheses, describe the data and findings and discuss their implications.

LITERATURE, THEORY AND HYPOTHESES

The literature suggests four key variables that would affect competitive prices: corporate size, quality, advertising and branding.

The effect of corporate size

The competitive advantage of larger size has long been stressed in the literature (Porter, 1980; Scherer, 1980). One issue which is less clear, however, is whether larger firms have higher or lower prices, i.e. how are firm size and firm prices related? There are competing theories about the sign of the relationship. Another issue is the type of advantages gained by the larger firms, i.e. does larger size confer economies of scale or scope?

Sign of relationship

One argument in industrial organization economics is that the larger firm holds a dominant position which is less vulnerable to competitive pressures. The dominant position could be due to advantages in supply or demand. Supply advantages include control over raw materials, patents, distribution outlets or superior technology which enable the firm to better tailor the product to the buyer. Demand advantages depend on consumer recognition of the brand. This recognition may be due to early entry of the firm, or current popularity with a large share of consumers. The advantage works especially with consumers who purchase by brand name due to loyalty, inertia, or switching costs, and may do so in spite of equivalent or superior products.

Dominant firms may cash in on these advantages by selling their products at prices much above costs or prices of smaller competitors. The dominant firm may pursue this strategy even if it permits the entry of marginal firms, provided the latter are not overly aggressive. As a result the relationship between relative size and price would be positive. Scherer (1980) suggests that this could be the reason why relatively larger firms have higher profits. The dominant firm hypothesis has had an impact on public policy towards relative firm size, where the pricing strategies of dominant firms are subject to greater scrutiny.

The above argument can also be extended to a group of large firms, if one assumes that their joint position is protected by mobility barriers (Porter, 1979). Such barriers lead to greater market power of the larger firms, which can be translated into higher prices through implicit collusion. For example, Chatterjee (1986) finds that collusive synergy (from horizontal mergers) creates more value than financial or operational synergies. His findings provide indirect support that mergers within an industry can promote price elevation by implicit collusion. The finding is relevant to the appliance industry that has witnessed steady expansion by large firms, both by internal development and external acquisitions.

Another line of argument is that large firms adopt a cost leadership strategy, serving the mass market with lower prices, made possible by economies of scale or scope and minimal differentiation; small share firms serve market niches with high-priced products, necessary to cover the higher costs due to their smaller scale or specialized marketing (Kotler, 1980; Porter, 1979, 1980). In this situation it is to the advantage of the small firms not to expand or position near the dominant firms, so as to avoid a price war. The latter scenario is relevant in a market such as appliances, where there is considerable scope for product differentiation and niche strategies. As a result the relationship between firm size and competitive price would be negative.

A third line of argument is that costly information could lead to a negative relationship between firm size and price (e.g. Salop and Stiglitz, 1977). Salop and Stiglitz argue that when some consumers are uninformed about competitive products and purchase randomly, some small, high-cost firms could exist in the market by passing on their higher costs with high-priced products targeted only to such uninformed buyers. On the other hand, firms that target both informed and uninformed consumers can pass on the savings from their larger scale of operation to consumers through lower prices.[1] If all consumers were well informed or able to shop around, high-cost, high-priced firms would be driven out of the market. In the appliance industry, given the large number of brands and the constant changes in specifications, it is quite possible that relatively smaller, inefficient firms exist with products targeted only to less-informed consumers.

In summary, then, we could expect one of two relations between firm size and competitive price. Under the dominant firm or market power hypotheses, relatively larger firms would have higher prices; under the market niche or the costly information theories which are probably more relevant to the appliance industry, smaller firms would have higher prices.

Type of economies

Because firms differ substanitally in the breadth of categories in which they compete, and their scale of operation in each category, we can identify at leat two sources of economies. First, the economies of scale that result primarily from the production of larger quantitites of any one product category. Such economies result from efficiencies in operation or from less than proportional increases in the costs of a factor as scale increases (Porter, 1985: 71). Economies of scale must be distinguished from economies of scope, experience or capacity utilization. Second, the economies of scope that result from linkages across product categories, either directly or through subsidiaries. Such economies are due to the sharing of the costs of production, marketing, purchasing, research and development and corporate staffing and organization over a broader product line (Abell and Hammond, 1979; Porter, 1980, 1985). Even for firms that do not produce, but only market appliances, a broad product line would help the fuller use of marketing investments in sales staff, distribution (warehousing, middlemen and transportation) and after-sales service. Researchers suggest that such economies may be responsible for the superior performance of related acquisitions (Singh and Montgomery, 1987).

The effect of quality

We define quality 'objectively' as a composite attribute of which consumers unanimously prefer more to less. It includes such dimensions as reliability, energy efficiency and freedom from defects as determined 'objectively' by a neutral team of experts. A 'subjective' definition of quality as 'value perceived by consumers' has been found to be an important determinant of market share and profitability (Jacobson and Aaker, 1985; Phillips, Chang and Buzzell, 1983). However, by definition, perceived quality would be influenced by pricing, market share or advertising because these variables may influence consumer perceptions. Indeed, a novel analysis of the PIMS data that allows for endogenous perceived quality finds that high price and exclusivity (small share) may positively influence perceived quality (Jacobson and Aaker, 1987). However, in our study we use the 'objective' definition of quality because the concern here is with whether objective quality is known and valued, whether consumers are getting their money's worth and the market is efficient.

Conventional wisdom suggests that differences in quality would be the primary cause of price variation. A large number of authors tested this simple hypothesis across a number of markets and time periods by measuring quality as objective

[1] In the Salop and Stiglitz (1977) model the equilibrium is complete with U-shaped average cost curves and high-priced firms getting an equal but small share of only unlucky uninformed consumers, and low-priced firms getting an equal but large share of both informed consumers plus lucky uninformed consumers. The existence of dealers responsible to consumers may not resolve the problem because: (1) the high-priced product may be of good enough quality so that it never is a hassle to the buyer; (2) the multiplicity of brand names, frequent dealer discounts and constant product innovation makes it unlikely that such 'uninformed' consumers would realize they could have got a better deal, e.g. some products of Maytag as can be determined from ratings by *Consumer Reports*.

rankings published by independent rating agencies. Contrary to conventional wisdom, the almost unanimous finding from all of these studies is that quality is not strongly related to price (Tellis and Wernerfelt, 1987).

More recent research has sought to determine the reasons for the weak impact of quality. One extreme scenario is developed by Akerlof (1970), who argues that if quality is difficult to evaluate before purchase, consumers would not be willing to pay more for it. As a result the market for quality will collapse and price would bear no relationship to quality. Tellis and Wernerfelt (1987) develop a more plausible theory. They argue that quality will command a higher price only to the extent consumers are informed about quality. They find support for their hypothesis that quality is more likely to command a premium for high cost, durables for which consumers are likely to be better informed both because of the durability of their purchase and the greater gains from search for such products. Based on their findings we expect better-quality brands to have higher prices in the home appliance industry.

Effect of advertising

Many writers in the popular and academic press have long suspected that advertising serves to elevate prices. The academic literature on this issue is extensive and controversial, with some scholars asserting that advertising serves to elevate prices and others arguing for its price-depressing effect (see reviews by Comanor and Wilson, 1979; Farris and Albion, 1980; Scherer, 1980). One school of thought is that advertising serves to differentiate products and thus could help to elevate prices (Bain, 1956; Comanor and Wilson, 1979; Scherer, 1980). This is not different from the position generally adopted in the normative strategy literature (e.g. Porter, 1980), where advertising is suggested as a means of avoiding destructive price competition. Some have argued that advertised products may be higher-priced because they provide consumers with information on products and reduce their search costs (Fergusson, 1982; Ehrlich and Fisher, 1982). Consumers in this case would be willing to pay the higher costs because they realize the savings in search costs, while firms use the higher markup to cover the costs of advertising and the risks associated with incurring those expenditures.

In contrast, other researchers believe that higher advertising must be associated with lower prices because of the inherent nature of this activity. In particular, Nelson (1974), argues that for 'search' goods, where quality could be ascertained before purchase, consumers could confirm the validity of an advertisement prior to purchase. Such behavior would motivate firms to be honest and to advertise only superior buys, e.g. lower-priced products (after adjusting for quality). The relationship between advertising and price would therefore be negative. For experience goods, where quality can be ascertained only after purchase, firms would not get by permanently with deceitful advertising. Knowing this, consumers are likely to consider more heavily advertised brands to be better buys (lower priced). So firms with lower prices will advertise more to signal consumers. In either case, Nelson expects advertising and price (adjusted for quality) to be negatively related.

Actually, by extending an information theory of advertising (Tellis, 1988; Tellis and Fornell, 1988), one could argue that if consumers were knowledgeable about quality, then advertising could provide useful information only about (lower) prices, and advertising and price would be negatively related; but if consumers were not so informed, then advertising would either provide an important service information to consumers or it could thrive on hyperbole and suggestion; in both of these cases it could serve to elevate prices. The relationship between advertising and price is thus also an empirical issue that depends on the behavior of consumers in particular markets.

The effect of reseller branding

Reseller branding refers to selling under a brand name not owned or related to the manufacturer, in contrast to manufacturer branding. Some firms use only manufacturer branding, some use only reseller branding (e.g. Sears), and some use a 'mixed brand strategy' selling under their own and reseller names (e.g. Whirlpool). This strategy could vary by model within a product category. The key issue is whether reseller brands are higher-priced than manufacturer brands after controlling for quality, advertising and scale effects. Arguments exist for either position.

One argument is that the situation may be similar to that for nondurables, where manufacturer brands are generally higher-priced than reseller brands. Possible reasons could be the national coverage and better-perceived quality of manufacturer brands, which are more likely to be the pioneers and market leaders of the segment; or the selective distribution of such brands through high-priced speciality stores. In contrast, the reseller brands are often owned by the retail store itself, which serves as buying agent for consumers, making available lower-priced alternatives, in a non-specialized retail environment. Indeed, reseller brands often compete only on price.

An alternative argument rests on the premise that the role of the manufacturer and retailer may be structurally different for durables. Because manufacturing is capital-intensive, some national manufacturers have concentrated on this task to the detriment of developing nationally recognized brands so that even the pioneer may in some cases sell only under reseller names. At the same time, chain stores often have so much power in the buyer–supplier chain as to demand that durables be sold only under their own name. For either of these reasons, reseller branding serves an important function of providing access and standing guarantee for the goods of an unidentified producer. This function may enable reseller brands to command a premium.

To summarize, if reseller brands serve as 'buying agents' providing cheaper products to consumers, their prices may be lower than manufacturer brands; but if reseller brands serve to guarantee quality or access to consumers, their prices may be higher.

EMPIRICAL ANALYSIS

Data and measurement

The data are from public sources as explained below. The term 'corporation' means the firm that owns the products being sold either directly or indirectly through a subsidiary. Corporations are identified by their 'corporate brand' name. The term 'brand', when used alone, stands for the label the firm chooses to sell its product under in a particular product market. The two names may be the same, as for Whirlpool, or different, as for GE and Hotpoint (see Table 1a). The term 'model' in this context means the variants of a brand in a product category due to physical characteristics, e.g. 'model MWED-5691', Montgomery Wards' washer with electronic display. To avoid errors in aggregation, wherever relevant, the data are retained at the disaggregate model level, even though we investigate potentially broader relationships.

Size

These data are from census statistics and industry sources, especially *Appliance*, a Dana Chase publication (Oak Brook, IL). We use several measures to capture the effects of firm size, because of the complexity of the industry and the underlying constructs. First, 'producer size' measures the annual dollar production in the category of the marketer of the product. By this definition, producer size includes volume produced but not marketed under the firm's brand name, because the advantages of the larger volume do accrue to the firm. On the other hand, retail chains (Penney, Sears and Wards) that do not manufacture the products they market have a zero on this scale. (The impact of such a strategy is captured by the 'branding' variable discussed next.) Second, 'corporate breadth' measures the number of categories in which this corporation is active, either directly or through subsidiaries. It can take on values from 1 to 10, as our data cover 10 categories. Third, 'corporate size' is a combination of the above two measures, and represents the sum across the categories of average annual producer size values. By definition, however, the corporate size records a zero for retail chains.

Fourth, to include the retail chains into the measure of corporate size and to account for the non-linearity in the effect of corporate size (Figure 1) we define 'corporate class' as a three-level categorical measure of corporate size (see Tables 1a, 1b). 'Broad' corporations are those that exceed $900 million in production or market in all categories. 'Narrow' corporations are independents or small corporations with less than $200 million in production and operating in only one or two categories.[2] The remaining

[2] The 'narrow' classification of J. C. Penney may be due to under-representation of its activity by *Appliance*. If this is true it would indicate an even stronger corporate scale effect than what we report later.

Table 1a. Corporate ownership of brands and corporate size in sample (in order of decreasing size)

Corporate brand	Brands owned	Corporate size (production in million $)	Corporate breadth (appliance categories)	Corporate class
Whirlpool	Whirlpool	3172	10	Broad
GE	GE, Hotpoint	2939	10	Broad
White Consolidated	Frigidaire, Gibson, Kelvinator White Westinghouse	1859	10	Broad
Magic Chef	Admiral, Magic Chef Fedders, Norge	927	10	Broad
Sears	Sears Kenmore Sears Lady	0	10	Broad
Montgomery Wards	Wards	0	10	Broad
Raytheon	Amanna, Caloric Speedqueen	697	9	Medium
Maytag	Maytag, Hardwick	656	7	Medium
Electrolux	OKM, Tappan	280	4	Medium
Matsushita	Panasonic, Quasar	110	2	Narrow
J. C. Penney	Penneys	0	2	Narrow
Independents	Carrier, Emerson, Friedrich, KithenAid, Litton, Norelco, Rheem, Roper, Sanyo, Sharp, Thermador, Toshiba, WasteKing	107		Narrow

Table 1b*. Distribution of observation by corpoate class

Number of product categories of corporate activity	Corporate size production in million $			
	Retailers	1–200	200–900	> 900
< 2	Narrow 3% brands 1% of observations	Narrow 40% of brands 15% of observations	Medium	Broad
2–9	Medium	Medium	Medium 19% of brands 20% of observations	Broad
> 9	Broad 8% of brands 13% of observations	Broad	Broad	Broad 30% of brands 51% of observations

* Carolyn Woo suggested this table.

corporations are 'medium'. Our classification is consistent with that in the literature (e.g. Curry, 1985).

With regard to the earlier theoretical discussion, potential economies of scale would be reflected in the producer size measure, with potential economies of scope reflected in the corporate breadth measure. The corporate size and class measures would reflect both types of economies plus any synergies that may result from having both, a large size and breadth of activity. All of these effects, if present, would be negative. Market power emanating from name recognition would be reflected primarily by the corporate breadth, while that emanating from either supply or demand advantages would be reflected by corporate size. These latter effects, if present, would be positive.

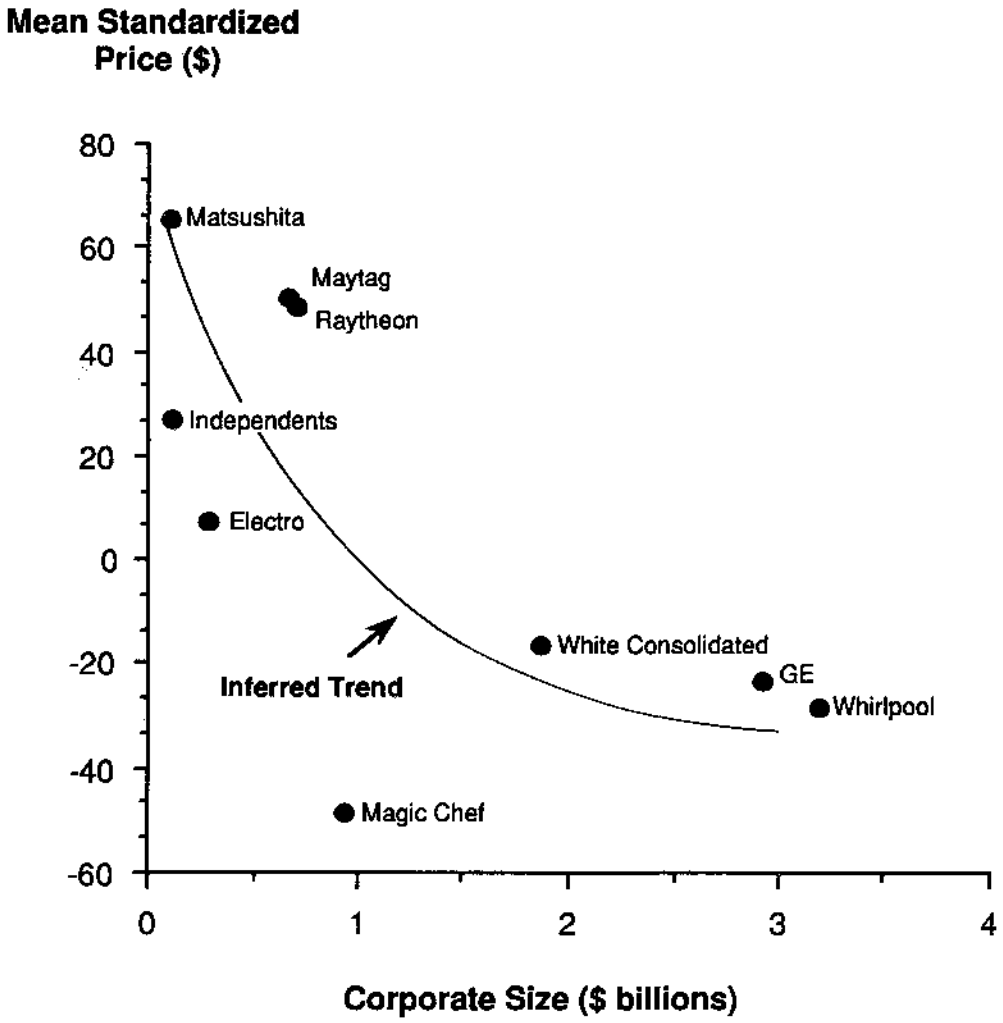

Figure 1. Plot of mean prices versus corporate size

Branding

Information on branding is obtained from the same sources as that for scale of operation. We intended to use a two-level nominal measure (manufacturer brand or not), but could not accurately classify some small independent brands, which we accordingly label as 'other'.

Quality

There are two independent organizations that systematically publish quality ratings across product categories: Consumers Union (CU) and Consumers' Research Inc. We used the former because they are more detailed, substantive, widely used and cover a broad cross-section of products over several decades. Compared to other measures in the literature (e.g. PIMS), CU's ratings are also more objective, reliable and valid, as discussed below.

Several factors contribute to the objectivity of CU's data. Most importantly, CU rates all the products by rigorous, blind, laboratory studies. It has no allegiance to any business organization, accepts no sponsors or advertisements and discourages use of its rankings in business ads. As a result, their ratings represent the most trusted source of information for consumers (Curry, 1985: 108). They also constitute one of the most

elaborate quality rating systems in the world (Thorelli and Thorelli, 1977).

To ensure reliability, CU generally has a panel of experts rating the various products. An indirect confirmation of retest reliability comes from the study by Curry (1985). His aggregation of CU's rating to the corporate level was very reliable, indicating both that manufacturer's maintained the same relative quality level over the products within a category over the 20 years, and that CU estimated that quality consistently.

CU derives an overall ranking of the tested brands (an ordinal quality measure). CU arrives at this by aggregating the ratings of those brands on numerous dimensions (covering both product attributes and features), and the estimate of the appropriate weights for these dimensions, based on the experts' study of the brands, usage occasions and users' objectives. The ranking is published only if the brand ratings on the dimensions are not negatively correlated, or the weights for those dimensions are not likely to vary substantially across consumers. Under these conditions, Curry and Faulds (1986) argue that such quality rankings are valid.

Price

Most of the prices reported by CU are means of prices reported by members, based on quotations they obtained from retailers. Generally these surveys cover a 2-month period over 11 to 16 cities. These prices must therefore be interpreted as post-discount retail prices for the brands. In two cases (of 19, see Table 2) CU indicates the prices are 'approximate retail', with no more details. These prices may have been obtained in a similar but less extensive survey. In three other cases, CU reported manufacturer-suggested retail prices. In these cases, although regional price variations do exist, because these are likely to be around the mean, and we focus on national patterns, such regional variations are not critical. Yet, we do test for heterogeneity of the results by source of price information.

Advertising

The advertising data are from publications of the Leading National Advertisers Inc. (LNA, New York, NY). While LNA publishes advertising data at various levels of aggregation, because our purpose is to test for broad generalizations and avoid seasonal distortions, we use only annual data.

Corporate brand names

The appliance industry is characterized by a large number of brand names. However, these names are associated with, or owned by, about 12 major corporations. We will examine the effects of the latter names on competitive prices. Significant price differences across brand names would indicate that corporations adopt different pricing strategies, consistently across categories. To the extent the independent variables can account for these differences, it would indicate why corporations consistently charge different prices for their products. If significant brand name effects remain after controlling for the independent variables, it would imply exlcuded independent variables, or measurement errors.

Sampling

The study is restricted to the major appliance industry over the 1981–84 period. In the 4-year period there were no significant shifts in corporate position. Within this frame the sample is broadly defined by the source of price and quality information, because CU evaluates only a select number of brands in a select number of product categories. Generally CU tries to evaluate at least one model for each non-negligible brand in each product category. In choosing categories CU is led by requests from its readers and the opinion of its specialists. As such, the sample is biased in the direction of product categories for which quality is more important and information more scarce, even though a review of any single year's publications indicates a broad cross-section of categories. Within the 4-year sample, major appliances which are newer, more popular and more likely to be bought by individuals (versus home-builders) are overrepresented (see Table 2). To avoid loss of information we do not drop replications of the same categories, especially as they cover different models of a category. Thus the sample may be a little biased[3] but the results

[3] It is difficult to state precisely the direction of the bias. For example, because evaluations are for categories for which quality is more important, the effect of quality may be overestimated. On the other hand, because evaluations are for categories in which quality is difficult to ascertain, the effect of quality may be underestimated.

Table 2. Sample description

Categories included in sample	Year evaluated	Models evaluated	Average price	Price source*	Average life span
Air conditioners (room)	1982	14	458	S	14
Dishwashers	1983	16	497	S	14
Dryers (electric)	1982, 1984	16, 19	358, 383	S,S	16
Dryers (gas)	1982, 1984	10, 19	406, 422	S,S	16
Freezers (Frost-free)	1982	2,	593	S	20
Uprights (chests)		9, 10	442, 408		
Microwave convection ovens	1981	4	805	L	14
Microwave ovens	1981, 1983	23, 17	509, 385	L,L	14
Refrigerators	1983	12	684	S	18
Ranges (electric)	1983, 1984	12, 16	657	R	20
Ranges (gas)	1984	5,7	578, 828	R	19
Washers: top load	1981, 82, 84	12, 12, 13	429, 447, 454	S,S,S	14
Washers: front load	1982, 1984	2,2	535	S,S,S	14
Excluded from Sample:					
Compactors	—	—			13
Disposers	—	—			12
Water Heaters	—	—			15

* S: survey retail quotations; L: suggested list (retail); R: approximate retail.

may be generalized with caution considering we have 238 observations from 19 evaluations of 10 categories.

ANALYSIS

Model

The above hypotheses and measures suggest the following testable model:

$$P^c_{bkmt} = \beta_0 + \beta_1 Q^c_{bkmt} + \beta_2 A^c_{bkt} + \beta_3 PS^c_{bkt} + \beta_4 B^c_{bkm} + \beta_5 CB^c + \beta_6 CS^c + \beta_7 CN^c + E^c_{bkmt} \quad (1)$$

where the superscript c represents corporation and the subscripts b, k, m and t represent brand, category, model and year respectively; β are the coefficients to be estimated and the roman letters represent the variables as below:

- P = the price measured in dollars
- Q = the quality[4]
- A = the advertising level in dollars
- PS = production size
- B = branding: manufacturer, reseller or other
- CB = corporate breadth
- CS = corporate size or corporate class
- CN = corporate brand names measured as dummy variables
- E = errors assumed independently, identically and normally distributed.

To account for the problem of simultaneity we also run a simultaneous-equation model in which size is a function of price, quality and advertising. Since we are interested in inter-category generalizations, to avoid category-specific effects we normalize the price, quality, advertising and scale variables to a mean of zero within categories.[5]

[4] Quality is measured as an ordinal variable but in most cases has a large number of levels (averaging about 12). Accordingly, treating it as interval for the regression analysis, while statistically incorrect, is not different from received practice in behavioral research, where rating (e.g. Likert) scales are treated as interval. In this empirical analysis the rank-orderings provided by *Consumer Reports* are reversed—the worst-quality product is ranked '1'. This is so that higher quality gets a high number, and the quality–price coefficients may be interpreted exactly as presented.

[5] Note that standardization within categories (prior to pooling), does not disturb the natural relationship existing among variables (subject to the caveat about pooling itself). This is because the strength and significance of a relationship between two variables, estimated by correlation analysis, is unaffected by standardization. The only change is in the form and interpretation of the coefficient. Also, standardization of variables to mean 0 does not affect the distance between intervals, so long as the original standard deviation is unchanged, as is carried out here. In particular the quality measure is unaffected by standardization.

(This is similar to the normalizations by Urban *et al.* (1986) in their analysis of pioneering across categories. We also carried out a normalization of mean zero and standard deviation of one within categories. In this case, though the model fit is a little better, the coefficient values do not change substantially, but are not immediately interpretable. So we keep the former normalization.) The model is estimated by ordinary least-squares and tested for non-linearities, interactions, alternative formulations and violations of the statistical assumptions about the error terms. Table 3 summarizes the hypotheses to be tested by equation (1).

Rationale for aggregation

We analyze competitive pricing across the whole sample of major appliances for several reasons. First, most of the home appliance sales are from large, broad companies that operate in several categories, but with the same competitive positions across categories (Hunt, 1972; Curry, 1985). An analysis across product categories is necessary to capture these strategic effects. The large corporations also use common brand names across categories, so consumers will associate common price, quality and brand images across categories. In addition consumer shopping behavior may be similar across major appliance categories (Newman, 1977). Thus buyer characteristics also warrant pooling across categories. Such pooling is common in cross-sectional studies on market structure and business strategy (e.g. Buzzell and Wiersema, 1981; Porter, 1979).

While some authors suggest pooling only on the basis of statistical homogeneity (e.g. Bass and Wittink, 1975), others point out that in empirical analysis statistical homogeneity may be rare, so that analyses solely on such tests may be too rigid (Wallace, 1972). There is actually a trade-off between the greater power and efficiency in pooled analysis, relative to the lower bias and greater detail of heterogeneous analysis. The issue may also be broader than merely a statistical one (Bass and Wittink, 1978). Basically, if the research goal is to test generalizations across categories, then the recovery of non-zero effects over the whole sample is not incorrect, especially since pooling weakens effect sizes (increasing the probability of a type II error). However, if the research goal is to recommend specific changes in practice, then an analysis of heterogeneity is imperative.

In the interests of developing parsimonious theory from empirical phenomena, Schoeffler (1977) suggests analyzing heterogeneity by the use of moderator variables that characterize the observations on some underlying dimensions (e.g. stage of PLC, purchase frequency, etc.) rather than by superficial categories (e.g. microwaves, washers, etc.) that distinguish them but have no theoretical underpinning. Accordingly, we test for heterogeneity of effects by interactions among all the independent variables and by source of price data. (However, this test can only account

Table 3. Hypothesized effects on price

Independent variable	Effect on price	Reason
Quality	Ha: Strong +	Firm reputations and costly quality production
	Hb: 0 or +	Premium for quality contingent on consumer information about quality
Advertising	Ha: +	Advertising differentiates products
	Hb: −	Advertising informs about better deals
Firm size	Ha: +	Larger firms are less susceptible to competitive pressure and hold higher prices
	Hb: −	Smaller firms serve market niches or uninformed consumers with higher prices
Reseller branding	Ha: −	Resellers serve an 'agency function' making available low-priced brands to consumers in unspecialized stores
	Hb: +	Resellers have greater power in durable goods due to better distribution and brand identification than manufacturers

for potential heterogeneity due to the independent variables in equation (1).)

Equation (1) relates price data at the model level to advertising data at the brand-name level (both within categories). This is not unreasonable, for several reasons. First, a review of CU's published data indicates that while the various models of a brand differ substantially by price, at each model level brands tend to maintain the same relative price position (e.g. within automobile classes, Toyota products are generally the most expensive and have the best quality). This premise is supported by Curry's (1985) study of the major appliance industry, which found relatively stable competitive price and quality positions, when aggregating over models, years and product categories. The stability is probably because the relative price and quality level is an outcome of basic management philosophy and the production set-up. More importantly, in the major appliance category, models differ not by brand names (as in the auto industry) but by obscure model numbers. Manufacturers are unlikely to design model-specific ads or expect these effects not to spill over to adjacent models. On the contrary, advertising is likely to be oriented to promoting the benefits of a particular brand name, which is common across models and is supported by consistent price and quality levels; casual observation supports such a position.[6]

RESULTS AND DISCUSSION

To better demonstrate the relative impact of the independent variables, Tables 4 and 5 present nested versions of equation (1). There is a weak non-linearity in the effects of quality, advertising and production scale (quadratic terms mostly not significant at the 0.05 level) and we do not pursue these effects. The strong non-linearity in the effect of corporate size is captured by corporate class. Other model formulations do not provide better fits. There are no strong interactions among the independent variables. An analysis of heterogeneity of the relationships by source of price information (survey or not) indicated no major differences. Multicollinearity is not a serious problem, as explained below.

The effect of quality is positive, strong and significant at the 0.001 level or better in all the models. Based on models 1–8, in absolute terms (at the rate of \$2.9–\$4.8 per rank), there is a difference of \$44–\$72 between the best and worst brands within the average product category of 15 brands. Thus quality does command a premium. However, it explains only about 6 percent of the variation in price (equivalent to a partial correlation coefficient of 0.25).

Model 2 in Table 4 indicates that advertising, when included alone, has a positive relation with price. However, model 3 shows that after controlling for quality the effect is not different from 0. This finding is important. Many critics base their conclusion that advertising leads to higher prices by a casual observation that higher-priced brands are more heavily advertised. These data indicate that higher-priced brands are also of better quality so that the effect of advertising is negligible after controlling for quality. Thus the Nelson (1974) hypothesis that advertising draws attention to or promotes quality cannot be rejected. On the other hand, the traditional view that advertising serves to elevate prices is not supported.

Models 4–7 analyze the effects of firm size. Both measures of size, producer size and corporate breadth, have a strong negative effect on price (model 4). But the effect of corporate size subsumes the effects of either of these measures as one would expect by its definition (model 5). Moreover, corporate size has an even stronger negative effect than either producer size or corporate breadth individually, suggesting a synergistic advantage of manufacturing at a large scale across categories. Corporate class, which also measures the activity of the chain retailers and captures non-linearities in the relationship (Figure 1), explains a little more of the variation in price (model 6). Actually, corporate class is the best explanatory variable in the model, individually explaining 20 percent of the variance. For corporate class the 'broad' and 'medium' levels must be evaluated against 'narrow', which is excluded from the model. In absolute terms, prices of broad-line firms tend to be as much as \$44 lower than those from narrow-line firms,

[6] In the empirical analysis we find very high inter-brand variation in advertising, as firms adopt widely differing advertising strategies; so measuring advertising at this higher aggregation level does not constitute a serious loss of information.

Table 4. Nested regression models of price ($, mean=0) (*t*-value in parentheses)

	Model						
Independent variable	1	2	3	4	5	6	7*
Quality	3.4 (3.8)		3.2 (3.4)	2.9 (3.2)	3.1 (3.6)	4.8 (1.8)	2.8 (3.2)
Advertising ($)		5.6 (1.8)	2.3 (0.7)	3.2 (1.0)	4.9 (1.6)	−2.1 (0.7)	2.1 (0.7)
Branding							
Manufacturer				31 (3.1)	56 (5.0)	13.0 (1.5)	13.2 (1.5)
Other				10 (0.7)	33 (2.1)	−6.8 (0.5)	−6.8 (0.5)
Reseller							
Producer size				−4.9 (2.3)	−2.1 (0.9)		
Corporate breadth				−4.5 (3.7)	−0.7 (0.4)		
Corporate size					−2 (4.5)		
Corporate class							
Broad						−44 (4.2)	−44 (4.3)
Medium						17 (1.4)	16 (1.4)
Narrow							
R^2	0.06	0.01	0.06	0.18	0.24	0.27	0.27
F (DF)	14.4	3.3	7.4	8.1	10.5	13.8	13.8
DF: N/D	1/235	1/235	2/234	6/230	7/229	6/230	6/230
Significance	0.002	0.0725	0.0008	0.0001	0.0001	0.0001	0.001

even after controlling for the effects of quality, advertising and branding.

Model 7 presents the effects of corporate class after allowing for the simultaneous effect of price on corporate size.[7] The effect of corporate class on price remains the same. The implication is that the path from corporate class to price is not a demand effect. This result should come as no surprise since corporate class, based as it is on corporate size and corporate breadth, represents fairly stable underlying characteristics of the firms involved. The negative signs of the size measures indicate that economies of scale or scope in the industry are probably being translated into lower prices.[8]

The effect of branding is also analyzed in models 4 and 7. A three-level nominal variable measures branding, where 'other' stands for small independents which could not be correctly classified as either manufacturer or reseller brands. The effect of manufacturer brand must be interpreted with respect to the level dropped (i.e. 'reseller brand' in 6 and 'other brand' in 7). Manufacturer brands have higher prices than reseller brands with a significant difference at the 0.1 level. This provides some support to the 'agency hypothesis', that reseller branding serves to identify and make accessible to consumers lower-priced products. In other words, in spite of the greater power of reseller brands over manufacturer brands in durables relative to non-durables, the former still appear to maintain lower prices to consumers.

Table 5 presents the analysis of corporate brand names.[9] It provides insight into the pricing strategies that may be attributed to particular corporate positions, both before and after controlling for the other variables in the model. All of these models were run with Magic Chef (the lowest-priced brand) excluded; so the effects of the other brands are in contrast to Magic Chef.

Model 8 tests for variation in prices attributable

[7] The simultaneous-equation model tests whether corporate class effects weaken when controlling for the simultaneous effect of price on corporate size. The price equation is the same as that in model 6, Table 4, because this model demonstrates the strongest effect of corporate size. The corporate size equation has quality and price as independent variables. (Advertising had no effect on corporate size.) The model is tested by maximum-likelihood estimation.

[8] Notice that this effect is even after accounting for potential simultaneity between the variables. The suggestion that economies of scale are passed on to consumers through lower prices is not inconsistent with the hypothesis that such firms charge lower prices and thus attract larger market shares, as indeed Salop and Stiglitz demonstrate (1977). Their analysis requires a market with some uninformed consumers. In fact we argue below that there is reason to believe that in this market consumer information on price and quality may not be perfect.

[9] Since there are 40 individual brands (see Table 1a), we restricted this analysis to corporate brands.

Table 5. Analysis of corporate brand effects, dependent variable = price (t values in parentheses; F values, significance of multi-level variables in square brackets)*

	Model			
Independent variables	8	9	10	11
Quality		3.0 (3.3)		2.37 (2.4)
Advertising ('000$)				0.0035 (1.1)
Corporate class			[30.5, 0.0001]	[31.4, 0.0001]
Broad			−111.1 (4.8)	−80.2 (−3.4)
Medium			−19.7 (0.85)	−10.0 (−0.44)
Branding:				
Manufacturer				49.38 (2.9)
Other				6.76 (1.8)
Corporate brand	[7.2, 0.0001]	[6.9, 0.0001]	[2.0, 0.04]	[2.2, 0.0216]
Matsushita	111 (4.8)	89 (3.7)	—	—
Maytag	103 (6.2)	98 (6.0)	12 (0.71)	17 (1.00)
Raytheon	91 (5.6)	80 (4.9)	—	—
Independents	72 (4.6)	66 (4.2)	39 (1.7)	−25 (−1.1)
Electro	54 (2.4)	58 (2.8)	−38 (1.7)	−15 (−0.70)
Sears	39 (2.4)	26 (1.6)	39 (2.4)	64 (3.1)
Wards	35 (2.0)	33 (1.9)	35 (2.0)	70 (3.3)
White Consolidated	33 (2.3)	32 (2.3)	33 (2.3)	20 (1.4)
G.E.	30 (2.1)	19 (1.3)	30 (2.1)	8 (0.49)
Whirlpool	30 (1.8)	16 (0.99)	30 (1.8)	4 (0.21)
J. C. Penney	29 (0.9)	13 (0.40)	−82 (2.2)	−27 (−0.69)
R^2 (F)	0.26 (7.2)	0.29 (7.7)	0.26 (7.2)	0.33 (7.1)
Significance	0.0001	0.0001	0.0001	0.0001
DF: N/D	11/225	12/224	11/225	15/221

* The F test for the multi-level nominal variables tests whether the additional variance explained by these variables is different from zero.

to corporate brands relative to Magic Chef. The significance and large spread in coefficients, with a premium of up to $111 for Matsushita, suggest that corporations have consistent and distinct pricing strategies across categories. A natural question at this point is whether these corporate brand effects would hold after controlling for quality. Model 9 tests for this situation. There is only a marginal decline in the F-value and the corporate brand coefficients, though four brands (G.E., Whirlpool, Sears and J. C. Penney) are now not significantly different from Magic Chef. From a consumer's perspective these four brands, together with Magic Chef, would represent good buys. The purchases of the other brands indicate the premium paid for competitive products, due possibly to ignorance of quality or use of surrogates for quality.

Since our previous analysis indicates that there are strong economies of scale, model 10 tests for corporate brand effects after controlling for scale effects. The pattern of brand coefficients changes dramatically, demonstrating that much of the interbrand variation in prices must be due to scale effects, as one may infer from Figure 1. In particular, the coefficients of J. C. Penney, Electrolux, Maytag and the independents drops substantially to insignificantly different from Magic Chef or negative, indicating that they probably suffer from inefficient scale relative to the broadline manufacturers.[10] The strong effect of corporate size further supports our previous analysis of the importance of this variable on price. Finally, model 11 presents the corporate brand effects after controlling for all the independent variables. We notice now that only two brands (Sears and Wards) have effects that are significantly different from Magic Chef. Thus the

[10] The loss of the Matsushita and Raytheon coefficients is due to the loss of degrees of freedom from including two sets of dummy variables, one for corporate brand and one for corporate scale effects.

independent variables can explain most of the inter-brand variation in prices.

An inspection of the correlation matrix indicates that multicollinearity is not a serious problem, because the continuous variables that were found to be non-significant in the regressions equations (advertising and production scale), had weak bivariate correlations with the dependent variable to begin with. On the other hand explanatory variables with strong correlations with price (quality and corporate size), revealed strong and stable partial effects in the regression equations. As for the brand name dummies, on purely technical grounds one could argue that there is collinearity between some of the corporate brand dummies and the corporate class. The position we take here is that the corporate class and the other independent variables, derived as they are from our theory, are underlying explanatory variables that are capable of 'explaining' the observed correlation between the corporate brand dummies and price.

CONCLUSION

While pricing has been the subject of research for several decades, most of this research has been theoretical. Empirical research on competitive pricing has been scarce. As a result we have a large body of literature that is rich, yet contains many rival theories. This study sought to integrate some of these theories into a testable model. The study is unique in that it analyzed price competition in an oligopolistic situation by controlling for several variables to understand their partial effects on price.

The most interesting result from this analysis is the strong corporate effect on competitive pricing. For example, even though prices were included at the model-number level, with quality as an independent variable at the same aggregation level, corporate brand names, corporate size and corporate class are still the best explanatory variables in the model. The result implies that a common corporate policy or mission permeates the pricing decision across model numbers, categories and time. It is consistent with prior findings of strategic positions in the industry (Hunt, 1972; Curry, 1985).

The strong negative impact of corporate size on price (which holds after controlling for other variables and possible reverse causality) suggests that economies of scale or scope are vital in this industry, and are at least partly transferred to consumers through lower prices. The result is especially important in the face of concern regarding the consolidation and consequent concentration in the industry. It is contrary to the dominant firm hypothesis that larger firms with broader product lines would have higher prices (e.g. Scherer, 1979, 1980). It also runs counter to the market power theory that possible mobility barriers and implicit collusion among large firms leads to higher prices. The finding is consistent with that from studies based on the PIMS data, which suggest that large firms are more profitable because of economies of scale rather than market power over prices. However, in this study we could not measure market share, which may have been a better proxy for market power. The strong effect of corporate size underscores the importance of competing at a large scale in all product categories, and probably explains the strong drive to consolidation in the industry. However, Figure 1 suggests that further consolidation among the broad-line firms may not lead to further lower prices.

While consumers can benefit from the presence of large firms by getting equivalent products at lower prices, the negative relationship between size and prices also has a less positive implication. If economies of scope or scale negatively affect prices, that implies that firms with higher prices survive in the market. Indeed, the analysis indicates that several well-known corporate brands do maintain substantially higher prices even after controlling for product quality. Further, the effects of corporate brand or corporate class greatly surpass that of the quality measure.

There is no support for the premise that advertising leads to elevation in prices. However, the data show that advertising and price are positively related only if quality is not accounted. Casual observation, or formal studies that indicate a positive relation between advertising and price without accounting for quality, must therefore be viewed skeptically.[11]

[11] One may argue that the effect of advertising is weak because its measure is at the brand level, while the price measure is at the model number level within brand. We earlier stated that the mismatch may not be that critical an issue, because competitive price and quality levels are probably set at the business or corporate level (Curry, 1985).

Reseller brands generally sell at equivalent or lower prices than manufacturer brands, after controlling for the effect of quality and potential economies of scale. This phenomenon parallels that for non-durables. However, in the case of durables this finding must be viwed in the context of the generally greater power of the resellers, many of whom constitute large chain stores. Indeed the insistence of these stores, of not selling except under their own brand name, could be viewed as the exercise of distribution power to limit the availability of competitive brands to consumers. However, this analysis shows that, in spite of their power, resellers do not charge higher prices for their service.

One interesting research topic would be to explore the effects of corporate size and position on quality and advertising. For example, would larger firms consistently offer better quality, and would they advertise more? Another research topic would be replicate this approach on other product categories. In particular, would these relationships hold for small appliances? Are there synergies in marketing and manufacturing both large and small appliances? A third research avenue would be to extend the analysis over time to capture time-related phenomena such as the effects of pioneering, experience economies, the product life cycle or advertising carry-over. A longitudinal analysis would especially help to unravel the evolution of causality among the key variables.

Another interesting question is why higher-priced firms survive in the market. The argument that it may be due to pioneering brands that have better reputations is not compelling, because in this industry pioneering is category-specific while the corporate brand effects are across categories. The reason that price differences are due to quality or advertising cannot be forwarded, because the price elevations hold even after controlling for these two variables. A fourth possibility is that higher-priced brands offer exotic features targeted to market niches (Kotler, 1980; Porter, 1985). This is partly supported by our finding that the higher-priced brands operate on a smaller scale, and that model-specific features sell at a premium. However, these features do not enhance quality much, and when they do, they are widely adopted in the industry. Moreover, the quality ratings in *Consumer Reports* are at the level of closely competitive models, after accounting for features.

The most plausible hypothesis is that the price variation is due to the incomplete consumer information on quality, due to inexperience or inadequate search (Salop and Stiglitz, 1977; Tellis and Wernerfelt, 1987). For example, the rate of innovation in the industry is so high (annual model changes are common) relative to the life span of major appliances, about 15 years (see Table 2), as to probably render some of the experience with previous purchases obsolete. On the other hand, in spite of the large number of brands, a large proportion of consumers purchase durables with minimal search (Newman, 1977). This must be coupled with the fact that quality is difficult to assess personally, and inconvenient or costly to access in publications such as *Consumer Reports*.

From a practical viewpoint several normative suggestions may be made with the usual caveats. For managers the study indicates that operating a broad product line across several categories may be important means of competing effectively in durable-goods industries. The discovery of corporate brand and scale effects, on model prices, underscores the persistence of corporate policy and position. While firms obtain higher prices if they manufacture their own rather than merely resell products, economies of scope appear strong enough, so that line extension by a reseller strategy may be profitable for narrow-line producers. Advertising is not automatically associated with higher prices for one's product, but improving quality relative to competitors may help a firm to hold higher prices relative to competitors.

For uninformed consumers with low opportunity cost of time, search should be profitable given the large price variation. Moreover, because of local price variation beyond the national averages reported in *Consumer Reports*, search could be very profitable. But if consumers have high search costs it is better to go with the large corporate brands. For public policy-makers the

[11] Continued.
Moreover, this fact is also supported by the very strong brand and scale effects on price, even though they are measured at much higher levels of aggregation than advertising! Most importantly, in the appliance industry, models are identified by obscure numbers. It is difficult to conceive of firms having a policy of intentionally advertising a particular model number without expecting or planning a halo effect on all model numbers of the same name. In casual observation we have not come across ads for specific model numbers.

study suggests that generalizations that more advertising or larger firms lead to higher prices may be inadequate, if not also misleading. Disaggregate analyses at the intra-industry level may be necessary and insightful.

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