Measuring Brand-name Effects in the Markets for Consumer Electronics and Appliances

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Abstract

In this paper we estimate brand-name effects for 9 types of products based on the approach used by Holbrook (1992) and Bello and Holbrook (1995). Following their idea, in hedonic price regressions we control not only for important product features that are typically included in product description, but also for the quality ratings that were measured in Consumer Union's laboratories, as well as for brand-name dummies. Even though the original research suggested that brand-name effects on price had been wiped out from most markets, we have found them to be statistically significant for 7 product subcategories out of 9. This generally supports the idea that brands play an important role in pricing despite the development of various web services allowing consumers to compare product features and prices easily. A possible measure of the intensity of brand-name effects on pricing is suggested. Some directions for further research and empirical generalizations are outlined.

Keywords: brand-name effect, hedonic regression, pricing

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1. Introduction

It is widely known from economics that under perfect information the price of goods is determined by their quality. However, as companies spend a lot of money on developing brand loyalty, academics and practitioners are interested in studying the role of quality and brand-name in explaining price differentiation. Manufacturers are interested in creating a strong brand, increasing awareness and creating positive perception of their products in the eyes of consumers to engender consumer loyalty. Consumers use, brands as signals of quality, which lowers the uncertainty when buying goods. On the other hand, one may think that now consumers do not have to rely on brand-name as a signal of quality anymore as they have access to information on the Internet that allows them to compare the price and objective quality of different brands. In some earlier research it is claimed that brand price premiums have disappeared from consumer product markets, indicating market efficiency (Bello & Holbrook, 1995; Holbrook, 1992). This conclusion is contradicted by other studies (Baltas & Saridakis, 2009, 2010; Fetscherin & Toncar, 2009; Park & Srinivasan, 1994; Swait, Erdem, Louviere, & Dubelaar, 1993). Our research was designed to test Bello and Holbrook's claim using up-to-date data and determine the level of brand price premiums in a range of consumer durables markets.

Brand price premium shows how much branded products cost compared to non-branded ones and is often considered to be the most objective measure of brand equity (Aaker, 1996). Brand price premium is estimated via hedonic regression, which models price as a function of product characteristics and brand-specific dummy variables. Empirical research conducted by Ailawadi and her co-authors (Ailawadi, Lehmann, & Neslin, 2003) showed that brand price premium is persistent over time, yet reflects changes in brand health and correlates with other estimates of brand equity.

In most product categories there are no unbranded products, though, which is why hedonic regressions with product attributes and brand-name dummy variables as explanatory variables are used to test whether there is a price premium for each brand relative to a benchmark brand. The presence of brand name effects can be inspected by testing the hypothesis that, other things equal, all brands cost the same (i.e. all coefficients at brand-name dummies jointly equal zero). Holbrook (Holbrook, 1992) demonstrated the absence of brand effects for various home-theater products. According to his research, the consumer electronics market cannot be considered ineffective. This result impeaches the role of brands in pricing and means that consumers only pay according to product quality. Holbrook's research stimulated other

studies that would show whether this conclusion can be generalized to other markets. Bello and Holbrook (Holbrook, 1995) studied 5 product categories: popcorn, coffee, recording tapes, colas and automobiles. And again, with minor exceptions, their results cast serious doubt on the viability of brand equity – measured as a brand price premium – in the markets for consumer products. Brand price premiums were found only for coffee. The authors explained this by the fact that coffee quality for consumers is largely determined by its taste, which cannot be assessed objectively.

While Bello and Holbrook found no brand-name premiums for automobiles (Bello & Holbrook, 1995), later research gave opposite results (Baltas & Saridakis, 2009, 2010; Fetscherin & Toncar, 2009). The existence of price premiums of certain brands has been revealed for toothpaste and mouthwash (Park & Srinivasan, 1994), jeans and athletic shoes (Swait et al., 1993). Such mixed results mean that questions as to which product categories the brand-name effect on price is significant and why this difference occurs are worth studying.

What distinguishes Holbrook's and Bello's and Holbrook's research from most other hedonic studies is that they accounted for product differentiation using Consumer Reports quality ratings that are based on laboratory tests, not just on characteristics declared by manufacturers. We use Bello's and Holbrook's approach to the identification of brand-name effects, but make changes in some aspects of the initial design, i.e. replicate their research with extensions (Hubbard & Armstrong, 1994). As the access to product price and quality data has significantly improved in the last 20 years, we were able to collect data on 9 important subcategories so that the samples are sufficiently large for reporting subcategory-specific results without aggregating them to product class level (in the original studies aggregation was necessary because of the insufficiency of sample size per subcategory). Due to some data limitations we were not able to study the same markets that were analyzed by Bello and Holbrook, so the subcategories differ from those used in the original studies. However this difference allows us to figure out whether the absence of brand-name effects can be generalized beyond the originally studied markets. A minor methodological modification that we made is using log-transformed price as the dependent variable instead of the raw price in dollars. This modification is justified in section 2 of the paper, where data and model specification are discussed.

2. Data and model specification

The empirical analysis is based on the data from Consumer Reports (www.Consumerreports.org) that was collected in April of 2012. The results of their laboratory tests give unique information about the objective quality of products. Consumer reports test only popular products that are widely available in the market. This solves a common problem of various hedonic studies, in which very expensive goods are often included in the sample and influence the analysis, even though they can have zero sales.

We model price as a function of quality rating, objective attributes and brand-specific dummy variables:

$$LnPrice_i = \beta_1 + \beta_{2i} quality_i + \sum_{k=1}^{K} \beta_{3ki} obj\_attribute_{ki} + \sum_{m=1}^{M} \beta_{4mi} brand_{mi} + \varepsilon_i , \quad (1)$$

where

- ***LnPrice*** – natural logarithm of the i^{th} product's price (the average last month's price according to Consumer Union research);
- ***quality*** – quality rating based on Consumer Union's laboratory tests;
- ***obj_attribute*** – objective product attribute, not accounted for in product rating. Such characteristics were included in the analysis if they were considered important by Consumer Union's specialists and published on the page "Ratings Overview" containing laboratory test results (the rest of the features are published on "Features & Specs" webpage);
- ***brand*** – brand specific dummy variable;
- ***K*** – the number of objective attributes;
- ***M*** – the number of brand-specific dummy variables.

The log-linear model is chosen for two reasons. First, it appeared to be a statistically more appropriate functional form. Second, it allows interpreting brand price premiums in percentage form. The expected coefficient signs are: β_2 is positive, β_3 may be positive or negative depending on the nature of an objective feature, brand-specific dummies are statistically insignificant, which would indicate the absence of brand price premium in the market. The specification that we used allows testing of whether there is a price premium for a particular brand compared to a benchmark brand.

Within some product categories there are several subcategories, which leads to significant heterogeneity. For example, printers are classified into ordinary printers and all-in-one devices, which in turn can be laser or ink-jet. The quality ratings are calculated for each subcategory individually and cannot be compared across subcategories. One more reason for doing the analysis at subcategory level is that some brands may have **recognition** in one of the subcategories, but not in the others, which can result in a misleading conclusion that there are no brand-name effects at the product class-level. We have chosen 9 subcategories, for which the sample size is sufficient for regression analysis: we required the sample size to be at least 10 times the product of the number of objective characteristics and the number of brand-specific number of variables (Table 1). This rule of thumb ensures that the sample size is large enough to reduce the possibility of type-2 error (i.e. accepting the wrong null hypothesis of no brand effect on price) to an acceptable level.

Table 1: List of subcategories used in the study

№	Subcategory	Number of		
		observations	brands	characteristics
1	Bottom-freezer refrigerators	98	5	2
2	Side-by-side refrigerators	88	3	2
3	Dishwashers	134	6	1
4	Front-loading washing machines	87	5	1
5	Cordless phones	63	3	1
6	Ink-jet all-in-one printers	61	5	1
7	Subcompact digital cameras	126	9	3
8	Top-loading washing machines	81	4	1
9	GPS navigators with 4.3-inch LCD screen	83	4	2

3. Empirical analysis

In order to estimate brand price premiums we figured out the price leader in each category and used it as a benchmark. The price leader is the brand that has the highest mean price among all brands, for which there are at least 10 observations in the sample. Brands that are represented by fewer than 10 products were merged into "Other brands" category. The list of brands for all subcategories is presented in Table 2.

Table 2: List of brands for each subcategory (price leader is mentioned first)

Subcategories	Brands
Bottom-freezer refrigerators	LG, Frigidaire, GE, Samsung, Whirlpool, other brands
Side-by-side refrigerators	GE, Frigidaire, Whirlpool, other brands
Dishwashers	KitchenAid, Bosch, GE, Kenmore, Whirlpool, other brands
Front-loading washing machines	Samsung, Frigidaire, GE, LG, other brands
Cordless phones	Panasonic, Uniden, other brands
Ink-jet all-in-one printers	HP, Canon Pixma, Epson, Lexmark, other brands
Subcompact digital cameras	Sony, Canon, Casio, Fujifilm, Nikon, Olympus, Panasonic, Samsung, other brands
Top-loading washing machines	Whirlpool, GE, Maytag, other brands
GPS navigators with 4.3-inch LCD screen	Garmin, Magellan, TomTom, other brands

Electronic devices and appliances are characterized by certain features, information about which is available before purchase. In addition, consumers often can check how product works before buying it. However, the number of characteristics is sometimes so large that consumers may prefer to rely on their awareness of brand reputation. Preliminary correlation analysis (Table 3) showed that the price-quality rating correlation is insignificantly different from zero for the most expensive products: namely, refrigerators. The highest correlation between price and quality rating is observed for GPS navigators

(0.757), which are relatively inexpensive products that can be easily compared based on their features available on the Internet.

Table 3: The description of subcategories

Subcategory	Price-quality rating Pearson correlation	Mean price, USD	Mean quality rating (out of 100)
Bottom-freezer refrigerators	-0.151	2054.55	67.49
Side-by-side refrigerators	0.014	1510.57	59.82
Dishwashers	0.321**	849.85	65.75
Front-loading washing machines	0.357**	1010.12	71.18
Cordless phones	0.395**	80.95	68.54
Ink-jet all-in-one printers	0.438**	136.23	65.49
Subcompact digital cameras	0.478**	170.63	48.44
Top-loading washing machines	0.493**	646.97	55.15
GPS navigators with 4.3-inch LCD screen	0.757**	187.65	62.82

** - statistically significant at 1% sig. level

For each subcategory we estimated equation (1) using OLS-regression with robust standard errors. Observations for which Cook's distance (a measure commonly used to detect influential observations) exceeded 4/n, where n is the number of observations, were dropped from the analysis (Chatterjee & Hadi, 1986). A statistically significant negative estimate of the coefficient at a brand-specific dummy variable would indicate that the brand charges less that the benchmark brand holding quality and objective product features constant. Table 4 gives an example of parameter estimates for the GPS navigation market.

Table 4: Parameter estimates for the subcategory of GPS navigators with 4.3-inch LCD screen

	Ln(Price)
Quality rating	0.043****
	(0.003)
Battery life (hours)	0.038
	(0.063)
Weight (oz.)	-0.074**
	(0.029)
Magellan	0.130*
	(0.067)
TomTom	0.230****
	(0.056)
Other brands	0.504****
	(0.138)
Constant	2.685****
	(0.266)
R^2	0.785
adj. R^2	0.765

Standard errors in parenthesis

* p < 0.1, ** p < 0.05, *** p < 0.01, **** p < 0.001

For the GPS navigation market all coefficients at brand-specific dummies are positive, i.e., other things equal, *Garmin,* the brand that seemed to be the price leader, actually charges less than other brands for the same level of quality. The exact values of price premiums compared to the benchmark are calculated as $(e^{\widehat{\beta_j}} - 1) \cdot 100\%$, where $\widehat{\beta_j}$ is a coefficient at the j^{th} brand's dummy variable. We found no brand effects for front-loading washing machines and ink-jet all-in-one printers. However, this result does not generalize to washing machines market in general: there are significant brand differences for top-loading washing machines (Table 5).

Table 5: Statistically significant price premiums for each subcategory

Subcategory	**Benchmark brand**	**Brands for which price premium is *significantly* different from zero (at 5% sig. level)**	**Price premium compared to the benchmark brand, %**
Bottom-freezer refrigerators	LG	GE Whirlpool	-18 -22
Side-by-side refrigerators	GE	Frigidare	-13
Dishwashers	KitchenAid	Kenmore Whirlpool	-38 -86
Front-loading washing machines	Samsung	–	–
Cordless phones	Panasonic	Other brands	-42
Ink-jet all-in-one printers	HP	–	–
Subcompact digital cameras	Sony	Canon Casio Nikon Panasonic Samsung	-40 -33 -19 -55 -44
Top-loading washing machines	Whirlpool	GE Other brands	-18 -18
GPS navigators with 4.3-inch LCD screen	Garmin	TomTom Other brands	+26 +66

We also tested whether price premiums relative to the benchmark brand differ from one another. For example, *GE* and *Whirlpool* bottom-freezer refrigerators are both cheaper than *LG* as Table 5 indicates, but is *Whirlpool* cheaper than *GE* or not? The answer is no: the difference between -22% and -18% appeared to be insignificant at the 5% significance level. In fact, there appeared to be no such differences except for the case of dishwashers, GPS Navigation and subcompact digital cameras markets. Other things being equal, Kenmore dishwashers are significantly more expensive than those from Whirlpool. For the GPS subcategory a statistically significant difference was detected between *TomTom* and other brands (represented in our dataset primarily by *Motorola*). The analysis of brand differences for subcompact digital cameras market was more meaningful: 4 out of 10 pairs of brand price premiums differ from each other (Table 6). We infer that the share of significantly different pairs of brands in the market may serve as a measure of the intensity of brand-name effects on pricing.

Table 6: Pairwise comparison of brand price premiums for subcompact digital cameras market ("+" – statistically significant (at 5% sig. level) difference, "–" - statistically insignificant difference)

	Canon	Casio	Nikon	Panasonic	Samsung
Canon					
Casio	–				
Nikon	+	–			
Panasonic	–	+	+		
Samsung	–	–	+	–	

4. Conclusion

Our study provides considerable empirical evidence in support of brand-name price premiums, after controlling for product differentiation, including quality rating that was measured in laboratory settings. The results of our regression analysis have shown that brand effects are statistically significant for 7 out of 9 markets. Usually, these brand-name effects are reflected in significant differences between the brand with the highest average price and some other brands. In the case of subcompact digital cameras we detected statistically significant differences between the price premiums of several brands, which means there is an unusually clear hierarchy of brands in this particular market. Therefore, even despite having an opportunity to get information about product features at low cost, consumers do tend to be brand-oriented and pay some price premium. This consumer behavior may occur because it is difficult to assess the relative importance of each of the many features and choose one of the numerous options in the market. Therefore brand name simplifies the search and the choice of a suitable product. In addition, many consumers may still find search costs prohibitively high.

Our results agree with some previous research that showed that consumers are willing to pay more to buy preferred brands (Jensen & Drozdenko, 2008). It is interesting that we have detected brand influence on price even though earlier studies by Holbrook and his co-authors (Bello & Holbrook, 1995; Holbrook, 1992) gave evidence of market efficiency and the absence of brand price premiums. At the least, our results indicate that the absence of brand-name effects cannot be generalized beyond the originally studied markets. Possible explanations of the divergence between our findings and those of Bello and Holbrook are the differences in product categories tested (relatively homogeneous products such as popcorn and recording tapes were considered in the original studies) and, more importantly, the fact that we reported subcategory-specific rather than product class-specific brand premiums. Some brands may have brand equity in some of the subcategories, but not in the others, which can lead to a misleading conclusion that brand-name effects are absent at the product class-level. Building class-specific models seems to be the best way to overcome the problem of small sample size at the time Holbrook and Bello's collected their data. We acknowledge that the analysis at subcategory level based on Consumer Reports data is still possible only for a small number of products.

Our research has some limitations. We still cannot be sure that all relevant quality indicators that may be correlated with certain brand indicators have been accounted for. For example, people may like the unique design that is characteristic of some brands. However, whether to consider design to be a component of product quality or not is an open question. The absence of brand price premium does not always indicate that brands do not influence consumer behavior. It may be the case that some of the brands are temporary pursuing a strategy that is incompatible with premium charging: e.g. the acquisition of new customers or market share growth. Finally, our research was limited to markets for appliances and electronics. It would be interesting to expand the research to cover services and FMCG products.

With the growth of hedonic studies reporting the role of brand-names on prices it is becoming possible to conduct meta-analysis of their results in order to explain under what conditions brand-name effects are usually detected. Explanatory variables may include market characteristics (such as average product price, its technical complexity and competitive intensity), estimation method, the presence of laboratory quality measures among regressors, etc.

Statistical significance of brand-name effects only tells us whether they are significantly different from zero or not. However, statistical significance does not measure the importance of brand-name effects, i.e. how much the inclusion of brand dummies add to the adequacy of a hedonic regression. We plan to increase the number of product subcategories and to decompose the explained sum of squares into components accounted for by product quality and brand-name. This would allow us to rank markets by the relative importance of brand-name vs. product quality.

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