TÜLIN ERDEM, YING ZHAO, and ANA VALENZUELA*

This article empirically studies consumer choice behavior with respect to store brands in the United States, the United Kingdom, and Spain. Store-brand market shares differ by country and are usually much higher in Europe than in the United States. The authors study the notion that the differential success of store brands in the United States and Europe is the higher brand equity that store brands command in Europe than in the United States. They use a framework based on consumer brand choice under uncertainty and brands as signals of product positions to conduct their analysis. More specifically, they examine whether uncertainty about quality (or the positioning of the brand in the product space); perceived quality of store brands versus national brands; consistency in store-brand offerings over time; and consumer attitudes toward risk, quality, and price underlie the differential success of store brands at least partially in the United States and Europe. The authors' model is estimated on scanner-panel data on laundry detergent in the U.S., U.K., and Spanish markets and on toilet paper and margarine data in the U.S. and Spanish markets. The authors find that consumer learning and perceived risk (and associated brand equity), as well as consumer attitude toward risk, quality, and price, play an important role in consumers' store-brand and national-brand choices and contribute to the differences in relative success of store brands across the countries studied.

Performance of Store Brands: A Cross-Country Analysis of Consumer Store-Brand Preferences, Perceptions, and Risk

Retailers own, control, and exclusively sell store brands, or private labels, which have been gaining an increasing share of the market in most consumer product categories. The trend toward higher store concentration, the global recession, and changing consumer habits also influence the growth of store brands. Nevertheless, the market shares of store brands vary by product class and across countries. For example, in the grocery industry, store brands in Germany have more than doubled their share of the market in four years, whereas store-brand growth in the United States seems to have stopped (Nielsen 1984). This trend results in an uneven penetration of store-brand share by country: 45% in Switzerland, 37% in the United Kingdom, 22% in Canada, and 12% in the United States (Dhar and Hoch 1997). Differences in market concentration, store-brand positioning, and consumer price sensitivity are responsible for this phenomenon (Bell, Davies, and Howard 1997; Blattberg, Eppen, and Staelin 1978); however, there has been little empirical research in marketing to study the reasons that underlie the relative strength of store brands in Europe and the United States.

The purpose of this arti cle is to study empirically the notion that the differential success of store brands in Europe

*Tülin Erdem is E.T. Grether Professor of Marketing, Haas School of Business, University of California, Berkeley (e-mail: erdem@haas.berkeley.edu). Ying Zhao is Assistant Professor of Marketing, Department of Marketing, Hong Kong University of Science and Technology (e-mail: mkyzhao@ust.hk). Ana Valenzuela is Assistant Professor of Marketing, College of Business, San Francisco State University (e-mail: avalenzu@sfsu.edu). The authors thank Guillermo Sanchez and Carmen Hernandez from ACNielsen Spain; Mike Bartlam and Mary Price from ACNielsen UK; and Mark Laceky, Matthew Bell, Kenneth Greenberg, Todd Hale, and Pam Sunderland from ACNielsen U.S. for providing the scanner-panel data used in this article. They also thank the anonymous *JMR* reviewers for their helpful comments on previous versions of this article. This research was supported by National Science Foundation Grant SBR-9812067 given to the first author and by a grant from the Hong Kong government (DAG02/03.BM54) given to the second author.

and the United States may be partially explained by the higher brand equity that European store brands command compared with that of U.S. store brands. Indeed, Erdem and colleagues (1999) indicate that the relative success of store brands in Europe may be partially due to store brands' commanding higher equity in Europe than in the United States, and they call for additional research in this area. In this article, we examine whether consumer uncertainty about store brands; perceived quality (or perceived positioning) of store brands; consistency in store-brand offerings over time; and consumer attitudes toward price, quality, and risk underlie the differential success of store brands in the United States and Europe.

We draw on previous literature on brand equity and consumer choice under uncertainty to build the framework for our study. On the basis of signaling theory in economics (Spence 1974; Tirole 1990), Erdem and Swait (1998) developed an information economics–based approach to brand equity. They associate the additional value with which brands endow products (Farquhar 1989) with the value of brands as signals of products' positions under consumer uncertainty and asymmetric information. In particular, Erdem and Swait suggest that a brand's credibility is crucial to its ability to signal product positions. They also suggest that consistency in brand positions over time, including consistency in the attribute (e.g., quality) levels of products, increases the credibility of a brand as a signal of a product's position, which may decrease perceived risk (variance of consumer quality perceptions) and information costs and increase perceived quality (mean of consumer quality perceptions) associated with a brand. The key point is that in this view, additional values associated with brands, or brand equity, are mainly driven by consistency and credibility, not necessarily by perceived quality.[1] Indeed, the importance of consistency and credibility in every aspect of brand strategy has been emphasized in previous managerial literature (e.g., Aaker 1991). Finally, Erdem (1998) estimates a structural model of brand choice under uncertainty about quality (or any imperfectly observable product attribute) to test the consumer behavior implications of using umbrella branding to signal the quality of a new experience good (Wernerfelt 1988).[2]

We estimate a similar model that explicitly incorporates the impact of uncertainty on consumer behavior. In our model, consumers are uncertain about quality levels (brand positioning in the product space) and have priors about quality. They learn about quality levels over time through use experience and update their quality perceptions on experience with the product. Consistency in quality levels over time ensures that use-experience information is less noisy, which decreases consumer perceived risk (variance of consumer quality beliefs). We estimate the model using scanner-panel data on laundry detergent for the United States, the United Kingdom, and Spain and on toilet paper and margarine data for the United States and Spain. Across the countries we study, we compare (1) levels of uncertainty associated with store brands and national brands; (2) consistency in product positions (quality) over time; (3) relative quality level of national brands and store brands; and (4) consumer sensitivity to price, quality, and risk. In addition, the proposed model allows for consumer heterogeneity in terms of quality perception, tastes, price sensitivities, and risk behavior.

We find strong empirical support for the idea that consumer uncertainty about quality (or any other imperfectly observable attribute), consumer learning, and perceived risk play important roles in consumers' store-brand and national-brand choices and contribute to the differences in the relative success of store brands across the countries we study. We also find that consumer attitudes toward risk, price, and quality explain partially differential market shares of store brands in frequently purchased packaged goods in the United States and Europe.

The rest of the article is organized as follows: In the next section, we provide a theoretical framework for our empirical analysis. We then describe the model and the estimation procedure. We subsequently discuss the data and empirical results, and we conclude with implications for further research.

CONSUMER LEARNING AND PERCEIVED RISK

Both psychologists (Fishbein 1967) and economists (Lancaster 1966) suggest that consumers perceive products as having several attributes. Consumers view a particular product in terms of where it lies between the set of attributes relevant to its product class, and they are likely to develop perceptions about where different brands are on each attribute.

Consumers may be imperfectly informed and thus uncertain about product attribute levels such as quality level. Product quality seems to be the attribute that consumers are usually uncertain about, according to research in information economics. As in previous research (e.g., Aaker 1991; Erdem 1998), we use the term "quality" to reflect any intangible or tangible product attributes (which may not be perfectly observable by consumers). This uncertainty may persist even after experience with a product, because use experience may provide only noisy information. Thus, consumer perceptions of quality levels may deviate from true levels (Erdem and Keane 1996). Furthermore, there may be inherent product variability; that is, the quality levels of different units of the same product may differ over time (Roberts and Urban 1988), which adds to consumer uncertainty.

Prior Uncertainty

When consumers are uncertain, they may develop expectations about product quality, which may be more precise (subject to less variance) for brands that have used consistent communications strategies over time and, as a result, have more consistent brand positions in the attribute space. Although prior uncertainty may be higher for store brands than for national brands, the difference in prior uncertainties associated with store brands and national brands may be less in Europe than in the United States because of more consis-

[1]Although higher perceived quality leads to higher brand equity, ceteris paribus, high perceived quality is not a necessary condition for high brand equity. For example, Kmart is not associated with high quality, yet it commands high brand equity because of its consistent, credible positioning, which provides good value and decreases consumers' perceived risk (variance of consumer quality beliefs).

[2]In the literature on brand signaling (and on consumer brand choice under uncertainty), quality (or perceived quality) is interpreted as a summary statistic that captures any intangible and tangible attributes of a product that may be imperfectly observable by consumers (for a review, see Erdem and Swait 1998).

tent communication strategies of European store brands. This may be a reason underlying the relative success of store brands in Europe.

Precision of Information Contained in Use Experience

As consumers experience products, their perceptions of product quality may change. Consumers learn about different brands from their experiences with the brands (Erdem 1998). Thus, if a product delivers consistent attribute levels over time, use experience will provide consumers with more precise information about product attribute levels, thereby decreasing consumers' perceived risk (variance of attribute level beliefs or variance of quality beliefs), more than if use experience provides more noisy information as a result of (real or perceived) inconsistent attribute levels over time. Thus, consistency in quality over time will lead to lower levels of perceived risk, ceteris paribus, which will lead to higher brand equity, ceteris paribus (Erdem and Swait 1998). Thus, an underlying reason that European store brands have higher market shares than U.S. store brands may be that the European store brands deliver more consistent quality levels to consumers than do U.S. store brands. If this is the case, European store brands would reduce consumers' perceived risk and increase risk-averse consumers' expected utility associated with store brands more than the U.S. store brands would do. Indeed, the literature on cross-category differences in store-brand market shares speculates that store-brand shares are likely to be higher in categories with low perceived consumer risk and lower quality variability (Batra and Sinha 2000).

Consumer Sensitivity to Price, Quality, and Risk

Other consumer-related mechanisms that may underlie such differences include the possibility that consumers' relative sensitivity to price is higher in Europe than in the United States and that consumers' relative sensitivity to quality and risk is lower in Europe than in the United States, which may also explain the greater success of European store brands than U.S. store brands.

Quality Differentials Between National Brands and Store Brands

Although the perceived or expected levels of quality for national brands may be higher than those for store brands in both Europe and the United States, the relative differences in perceived quality levels between national brands and store brands may be lower in Europe than in the United States. Indeed, although most consumers may choose store brands because of the price advantage, high quality seems to be more important than low price in determining store-brand success (Sethuraman 1992).

We develop and estimate a model that, for the first time in the literature, explicitly accounts for the factors we have discussed that may underlie differences in market shares in given categories across the United States and Europe.

MODEL

Consider a market in which there is a set of consumers $I = \{i|i = 1, 2, ..., I\}$, and $J = \{j|j = 1, 2, ..., J\}$ is the set of brands that includes both national brands and store brands in the market. The consumers' purchases are observed over the period $T = \{t|t = 1, 2, ..., T\}$, where T is the time span.

Consumers may be imperfectly informed and thus uncertain about product quality. Research in information economics usually refers to the overall quality of a product as the product attribute about which consumers are uncertain. We emphasize that we use the term "quality" as a summary statistic that reflects both tangible and intangible attributes of a product, as has been done in previous literature on brand choice under uncertainty (e.g., Erdem 1998). Thus, we define the following:

$$X_{ij_nt} = A_{j_n} + x_{ij_nt}, \text{ and} \quad (1)$$

$$X_{ij_st} = A_{j_s} + x_{ij_st}, \quad (2)$$

where X_{ij_nt} is the overall quality level of national-brand j_n that consumer i would have perceived at time t if consumer i purchased the brand at time t, A_{j_n} is the (true)[3] mean quality level for national-brand j_n, and x_{j_nit} is an i.i.d. random error term.[4] The variable x_{ij_nt} can reflect not only the possibility that a consumer may randomly get a "lemon" or a "windfall" but also a consumer's inability to evaluate the quality level perfectly. We denote the overall quality level, mean quality level, and random error term for the store brands as X_{ij_st}, A_{j_s}, and x_{ij_st}, respectively. In summary, Equations 1 and 2 show that experience with a brand provides imperfect information about the brand's true product quality.

We assume that consumers learn about the means of quality levels of national brand and store brand (A_{j_n} and A_{j_s}) through Bayesian updating. Previous literature suggests that the Bayesian updating mechanism often provides a reasonable fit to observed choice behavior (Erdem 1998; Erdem and Keane 1996; Roberts and Urban 1988). We also assume that consumers' priors on the quality levels A_{j_n} and A_{j_s} are normally distributed at time t = 0.

$$A_{j_n} \sim N\left(\bar{A}_{j_n}, \sigma^2_{A_n}\right), \text{ and} \quad (3)$$

$$A_{j_s} \sim N\left(\bar{A}_{j_s}, \sigma^2_{A_s}\right), \quad (4)$$

where $\bar{A}_{j_n}$ is the prior mean perceived quality levels for national-brand j_n, such that $E_{0i}[A_{j_n}] = \bar{A}_{j_n}$ for each consumer, and $\sigma^2_{A_n}$ is the prior variance of the national brand's quality level as perceived by consumer i at t = 0. We denote the prior mean perceived quality levels and the prior variance of the store brand's quality level as $\bar{A}_{j_s}$ and $\sigma^2_{A_s}$, respectively. We assume that x_{ij_nt} and x_{ij_st} (i = 1, 2, ..., I; j = 1, 2, ..., J; and t = 1, 2, ..., T) are normally distributed. The variables $\sigma^2_{A_n}$ and $\sigma^2_{A_s}$ capture consumers' initial uncertainty with the national and store brands, respectively (initial or prior variance of perceived quality levels). In previous work on brand choice under uncertainty, all brands were assumed to have the same prior variance; thus, this is the first work that allows brands (specifically, store brands versus national brands) to have different prior variances.

The random error terms associated with consumer latent attribute (quality) perceptions are distributed as

[3]True mean quality does not have a one-to-one correspondence to an objective level, because some of the "quality" dimensions would be intangibles for which objective levels may not even exist. We estimate A's as parameters of the model to reflect mean quality perceptions (for details, see Ackerberg 2000; Erdem and Keane 1996).

[4]Note that A's are imperfectly observable from the consumers' point of view and are "latent" variables for researchers.

$$x_{ij_nt} \sim N\left(0, \sigma^2_{x_n}\right), \text{ and} \tag{5}$$

$$x_{ij_st} \sim N\left(0, \sigma^2_{x_s}\right), \tag{6}$$

where $\sigma^2_{x_n}$ and $\sigma^2_{x_s}$ are the experience variabilities for national brands and store brands, respectively. We assume that x_{ij_nt} is i.i.d. across consumers, national brands, and time period and that x_{ij_st} is i.i.d. across consumers, store brands, and time periods. The experience variabilities capture the noisiness of information contained in use experience ($1/\sigma^2_x$ is the precision of information contained in a signal in Bayesian updating). The higher the variabilities, the less diagnostic is each use experience in resolving uncertainty about quality levels that is due to either inherent true product variability (true quality levels fluctuating around a mean over time) or consumers' inability to assess true quality levels (e.g., perceived inconsistency in consumed quality levels as a result of situational factors).[5] It might be expected that $\sigma^2_{x_n} < \sigma^2_{x_s}$, because national brands may achieve higher quality standardization.

Because consumers behave as Bayesian updaters, their expectations of the latent attribute levels (e.g., quality) can be described as follows:

$$E_{it}\left[A_{j_n}\right] = A_{j_n} + z_{ij_nt},\ z_{ij_nt} \sim N\left(0, \sigma^2_{Aij_nt}\right); \text{ and} \tag{7}$$

$$E_{it}\left[A_{j_s}\right] = A_{j_s} + z_{ij_st},\ z_{ij_st} \sim N\left(0, \sigma^2_{Aij_st}\right). \tag{8}$$

Here, z_{ij_nt} denotes consumer i's expectation errors at time t for national-brand j_n, and $\sigma^2_{Aij_nt} = E[(A_{j_n} - E_{ti}[A_{j_n}])^2]$. The variable $\sigma^2_{Aij_nt}$ denotes the variance of consumer i's expectation errors associated with brand j_n at time t as perceived by consumer i. This reflects the variance of consumer quality (or imperfectly observable attribute) beliefs and represents perceived risk to consumers. The variables z_{ij_st} and $\sigma^2_{Aij_st}$ are consumers' expectation errors associated with store-brand j_s and the variance of expectation errors associated with store-brand j_s, respectively.

At time t, consumer i updates his or her expectation of the mean of the quality level A_{j_n} and A_{j_s} by using the received information contained in surprise elements of the experience with brands j_n and j_s.

Thus, according to the Bayesian rule,

$$E_{ti}\left[A_{j_n}\right] = E_{t-1,i}\left[A_{j_n}\right] + \sum_{j_n=1}^{J_n} D_{ij_nt}\beta_{ij_nt}\left(X_{ij_nt} - E_{t-1,i}\left[X_{ij_nt}\right]\right), \text{ and} \tag{9}$$

$$E_{ti}\left[A_{j_s}\right] = E_{t-1,i}\left[A_{j_s}\right] + \sum_{j_s=1}^{J_s} D_{ij_st}\beta_{ij_st}\left(X_{ij_st} - E_{t-1,i}\left[X_{ij_st}\right]\right), \tag{10}$$

where D_{ij_nt} equals one if consumer i purchases national-brand j_n at t and equals zero otherwise. The variable D_{ij_st} equals one if a consumer purchases store-brand j_s at t and equals zero otherwise. Note that in the preceding equations, we assumed that a consumer updates his or her quality perception of a national-brand j_n every time he or she buys a national brand from the set j_n. Likewise, a consumer updates his or her quality perception for store-brand j_s each time he or she buys a store brand from the set J_s.

The βs are Kalman gain coefficients we obtained from the Kalman filtering algorithm.

$$\beta_{ij_nt} = \frac{\sigma^2_{Aij_nt}}{\sigma^2_{Aij_nt} + \sigma^2_{x_n}}, \text{ and} \tag{11}$$

$$\beta_{ij_st} = \frac{\sigma^2_{Aijst}}{\sigma^2_{Aij_st} + \sigma^2_{x_s}}, \tag{12}$$

where β_{ij_nt} is the weight attached to the information from previous purchase of national-brand j_n by consumer i when he or she evaluates the quality level of brand j_n at time t. In addition, β_{ij_st} is the weight attached to the information from use experience of store-brand j_s by consumer i when he or she evaluates the quality level of brand j_s at time t.

Consumer i also updates the variance $\sigma^2_{Aij_nt}$ and $\sigma^2_{Aij_st}$ of the quality levels for national-brand j_n and store-brand j_s at time t.

$$\sigma^2_{Aij_nt} = \left(1 - \beta_{ij_nt}\right)\sigma^2_{Aij_nt-1}, \text{ and} \tag{13}$$

$$\sigma^2_{Aij_st} = \left(1 - \beta_{ij_st}\right)\sigma^2_{Aij_st-1}. \tag{14}$$

Note that the variances capture consumer perceived risk (because quality beliefs have a variance). Given Equations 11–14, the variances would be lower. The lower the prior uncertainty (i.e., the lower are the prior variances of quality beliefs [$\sigma^2_{A_n}$ and $\sigma^2_{A_s}$]), the more diagnostic or precise is the use-experience information (i.e., the smaller are the experience variabilities $\sigma^2_{x_n}$ and $\sigma^2_{x_s}$).

Both perceived quality and perceived risk have been proposed in the literature as components of brand equity (Aaker 1991; Erdem and Swait 1998). In our model, we denote the mean (perceived) quality levels as A, and we denote perceived risk (variance of quality beliefs) as σ^2_A (Erdem 1998; Erdem and Keane 1996).

In this article, we follow the tradition of the internal structure of market analysis literature (e.g., Elrod 1988; Elrod and Keane 1995; Erdem 1998), which imposes a factor-analytic structure on the brand-specific constants and decomposes the brand-specific constants that are commonly estimated in brand-choice models into attribute locations (A) and weights attached to them (w). The A's in our model represent latent attribute locations for each brand. In other words, they capture the positioning of the brand in the product space.

The literature on internal analysis of market structure refers to the A's as "latent" because they are unobservable. When two latent attributes (common factors) have been estimated, the A's have been referred to as latent "attributes" (e.g., Elrod 1998; Erdem and Keane 1996), leading to two-dimensional market maps. When one latent attribute (common factor) was estimated, the A's have been referred to as "perceived quality," leading to a one-dimensional map (e.g.,

[5]There may be several reasons that consumer experiences provide only imperfect information: It may take a long time to learn about product characteristics (e.g., a consumer may realize that a particular brand of detergent fades colors after several months of use); the experience may be context dependent (e.g., a consumer may not observe that the detergent does not remove a particular stain until after such a stain is present in the laundry).

Erdem 1998), and the term "quality" was used as a summary statistic of various intangible and tangible brand attributes, as is the case in this article. As does Erdem (1998), we also label the A's as (mean) perceived quality.

Finally, σ_A^2 refers to the variance of quality beliefs of the individual consumer. If a given consumer's quality beliefs have a variance of zero, the implication is that the consumer has no uncertainty about quality levels and thus no perceived risk.

In our modeling framework, "brand equity" comprises consumer perceived risk, as captured in Equations 13 and 14, and expected attribute (or quality) levels, as captured in Equations 9 and 10. Thus, brands with higher equity will have lower perceived risk (lower variance of consumer quality beliefs) and/or higher expected attribute levels (higher mean quality beliefs or perceptions), ceteris paribus. We note that in a reduced-form modeling setting, the brand-specific constants, which have often been labeled "brand-equity terms" (Kamakura and Russell 1993), embed the effects captured in Equations 9, 10, 13, and 14. We also emphasize that the purpose of our article is not to provide a full measure of brand equity; rather, we aim to test whether certain concepts that have been proposed and shown to be components of brand equity help explain the differential success of store brands in the United States and Europe.

Recall from Equations 7 and 8 that z_{ij_nt} and z_{ij_st} denote the consumer perception errors at time t for brand j_n and brand j_s. Thus $z_{ij_nt} = E_{ti}[A_{j_n}] - A_{j_n}$, and $z_{ij_st} = E_{ti}[A_{j_s}] - A_{j_s}$. In addition, because x_{ij_nt} and x_{ij_st} have means of zero, $E_{t-1,i}[X_{ij_nt}] = E_{t-1,i}[A_{j_n}]$, and $E_{t-1,i}[X_{ij_st}] = E_{t-1,i}[A_{j_s}]$. Given these expressions, Equations 9 and 10 can be written as follows:

$$(15)\quad z_{ij_nt} = z_{ij_nt-1} + \sum_{j_n=1}^{J_n} D_{ij_nt}\beta_{ij_nt}\left(x_{ij_nt} - z_{ij_nt-1}\right), \text{ and}$$

$$(16)\quad z_{ij_st} = z_{ij_st-1} + \sum_{j_s=1}^{J_s} D_{ij_st}\beta_{ij_st}\left(x_{ij_st} - z_{ij_st-1}\right).$$

Expected Utilities

We assume that U_{ijt}, the utility of consumer i from purchasing brand j at time t, depends on the perceived quality level X_{ijt} and price P_{ijt}. Here, j is from the whole choice set J that includes both national brands and store brands. Thus, in this section, we drop the subscripts s and n to denote store and national brands, and what follows applies to both. To capture uncertainty in product quality and attitudes toward risk, we need a flexible specification for U_{ijt} to allow for risk-averse, risk-neutral, and risk-taking behaviors. Thus, we allow U_{ijt} to depend nonlinearly on X_{ijt}. The quadratic form is such a nonlinear utility function that captures risk aversion and risk taking (Bell and Raiffa 1988):

$$(17)\quad U_{ijt} = \alpha_i P_{ijt} + \omega_i X_{ijt} + \omega_0\gamma_i X_{ijt}^2 + \varepsilon_{ijt},$$

where α_i and ω_i are the price sensitivity and utility weight of the perceived quality for consumer i, respectively, and are heterogeneous across consumers. The variable ω_0 is the mean utility weight of the square of perceived quality levels, and γ_i is the heterogeneous risk-aversion coefficient. If $\omega_0 > 0$, then $\gamma_0 < 0$ suggests risk aversion at the mean, where γ_0 is the mean of γ_i. Risk-taking behavior at the mean is suggested by $\gamma_0 > 0$, and risk neutrality at the mean is suggested by $\gamma_0 = 0$. The variable ε_{ijt} is a time-varying stochastic component of utility, which we assume to be an i.i.d. extreme value, and captures random unobservable preference shocks that are known by the household. Note that the functional form of the utility specification, by definition, has implications for consumer risk behavior and for other consumer behavior phenomena. For example, if the empirical results show evidence for diminishing marginal returns to quality (or the attribute in question), that is, for concavity, this suggests risk aversion and "attribute satiation" (because attribute satiation has been often defined as diminished marginal returns to an attribute). However, we note that whereas concavity, by definition, implies risk aversion, concavity itself does not imply uncertainty. As we show subsequently, concavity only implies that if there is uncertainty, expected utility decreases in uncertainty.

To capture consumer unobserved heterogeneity in price sensitivities, utility weights, and risk-aversion coefficients, we model unobserved heterogeneity as random effects and adopt the continuous approach (Allenby and Rossi 1999). Thus, we assume that $\alpha_i \sim N(\alpha_0, \sigma_\alpha)$, $\omega_i \sim N(\omega_0, \sigma_\omega)$, and $\gamma_i \sim N(\gamma_0, \sigma_\gamma)$. The utility function can be expressed as

$$(18)\quad U_{ijt} = V_{ijt} + \varepsilon_{ijt},$$

where

$$(19)\quad V_{ijt} = \alpha_i P_{ijt} + \omega_i X_{ijt} + \omega_0\gamma_i X_{ijt}^2.$$

Consumers form expectations about product quality and thus about the utility they derive from consuming a brand. Thus, the expected utility of consuming brand j at time t for consumer i, given the information consumer i has at time t, is

$$(20)\quad E_{ti}[U_{ijt}] = E_{ti}[V_{ijt}] + \varepsilon_{ijt}.$$

Given the definition of V_{ijt},

$$(21)\quad E_{ti}[V_{ijt}] = \alpha_i P_{ijt} + \omega_i E_{ti}[X_{ijt}] + \omega_0\gamma_i E_{ti}[X_{ijt}^2].$$

Equation 21 can be rewritten as follows:

$$(22)\quad E_{ti}[V_{ijt}] = \alpha_i P_{ijt} + \omega_i E_{ti}[X_{ijt}] + \omega_0\gamma_i E_{ti}[X_{ijt}]^2 + \omega_0\gamma_i E_{ti}[(X_{ijt} - E_{ti}[X_{ijt}])^2].$$

According to Erdem (1998), Equation 22 can be rewritten as follows:

$$(23)\quad E_{ti}[V_{ijt}] = \alpha_i P_{ijt} + \omega_i(A_j + z_{ijt}) + \omega_0\gamma_i(A_j + z_{ijt})^2 + \omega_0\gamma_i(\sigma_{Aijt}^2 + \sigma_{xj}^2),$$

where we assume that the experience variabilities, σ_{xj}^2, are different for store brands and national brands, but we estimate one experience variability for national brands and one for store brands (in previous work, all experience variabilities have been assumed to be the same for all brands; e.g., Erdem 1998).

The preceding equations suggest that the expected utility under risk aversion will be higher the more experience a consumer has with brand j, the more precise the information is that is gained through experience, and the lower the prior uncertainty is associated with that brand, ceteris paribus. We note several points pertaining to Equations 22 and 23. Given the functional form of the utility function, depending on the

signs of parameters estimates of ω_0 and γ_0 (where γ_0 is the mean of γ_i), risk-averse, risk-neutral, or risk-seeking behavior may result. Thus, we do not impose risk aversion a priori. If $\omega_0 > 0$ and $\gamma_0 < 0$, there exists a concave utility function that suggests diminished marginal returns to quality, which also suggests that expected utility decreases in the expectations over the squared deviations of quality levels from expected quality levels (i.e., $E_{ti}[(X_{ijt} - E_{ti}[X_{ijt}])^2]$) and variance of quality belief (i.e., $\sigma^2_{A_{ijnt}} = E[(A_{j_n} - E_{ti}[A_{j_n}])^2]$). Thus, if $\omega_0 > 0$ and $\gamma_0 < 0$, we determine that consumers prefer to avoid any such deviations and thus are risk averse at the mean (i.e., the average consumer is risk averse). In contrast, if $\gamma_0 = 0$, the implication is that consumers are insensitive to such deviations and thus are risk neutral at the mean. If $\omega_0 > 0$ and $\gamma_0 > 0$ (i.e., if utility function is convex in quality), the implication is that expected utility increases in $E_{ti}[(X_{ijt} - E_{ti}[X_{ijt}])^2]$, which suggests risk-taking behavior at the mean under uncertainty (thus, consumers may receive higher or lower quality than they expected, from which they derive positive utility).

Finally, if consumers are found to be risk averse in the mean (i.e., the average consumer is risk averse), the implication is that, keeping everything else constant, consumers prefer brands about which they are certain over brands about which they are uncertain. However, we note that this does not mean that consumers will prefer a low-quality brand with certainty over a brand whose expected quality is higher but for which the consumer does not know the quality level. Expected utility is a function of expected quality (means) as well as the variance term. The mean expected quality may be high enough for a brand that a risk-averse consumer would prefer a brand associated with high expected quality and some variance of quality beliefs (provided that that the consumer is quality sensitive) over a brand with a low expected quality level and low or zero variance of quality beliefs (the consumer is almost sure that the brand is low quality).

Choice Probabilities

Under the assumption of an i.i.d. extreme value error term ε, the probability of consumer i choosing brand j at time t takes the form of a multinomial logit choice probability (McFadden 1974):

$$q_{ijt} = \frac{e^{E[V_{ijt}]}}{\sum_{l=1}^{J} e^{E[V_{ilt}]}}. \tag{24}$$

This probability is conditional on the price sensitivities α_i, the attribute weights ω_i, the risk-aversion coefficients γ_i, and the consumer expectation errors z_{ijt}. For each consumer i, we denote the collection of the random variables by υ_i. Thus, the likelihood of consumer i making the purchases indicated by D_{ijt} is given by the following:

$$L_i(\theta) = \int_{\upsilon_i} \prod_{t=1}^{T} \prod_{j=1}^{J} q_{ijt}(P_{it}, A|\upsilon_i)^{D_{ijt}} f(\upsilon_i) d\upsilon_i, \tag{25}$$

where θ is the parameter vector that consists of α_0, σ_α, ω_0, σ_ω, γ_0, σ_γ, σ_{A_n}, σ_{A_s}, A_{j_n}, A_{j_s}, σ_{x_n}, and σ_{x_s}. Thus, we estimate a heterogeneous logit model (mixed logit model). In terms of the distributional assumptions of the stochastic utility (error terms, or preference shocks, that consumers observe but the researcher does not) and the random effects (preference heterogeneity and price-sensitivity heterogeneity) that enter the deterministic component of utility, we note that we assume that the covariance between the random effects in the deterministic component of utility (preference heterogeneity and price-sensitivity heterogeneity) and stochastic utility (error terms or preference shocks) is zero. The same assumption is made in many discrete-choice models irrespective of the distributional assumptions about the stochastic utility (e.g., the same assumption is made when the error terms or preference shocks are assumed to be normal, leading to a probit model).

Cross-Country Comparisons

As we previously discussed, we are interested in comparing (1) initial uncertainty associated with store brands (versus national brands); (2) the precision of information contained in use experience associated with store brands (versus national brands), as a result of both quality consistency over time and consumers' ability to evaluate the consumption experience (i.e., the consumed quality levels); (3) the perceived quality levels of store brands (versus national brands); and (4) consumers' price and quality sensitivities and their extent of risk aversion (or risk taking) across the three countries in our study.

In comparing parameter estimates across data sets, logit models (and probit models) pose a problem because the parameters are identified only up to a scale constant (Ben-Akiva and Lerman 1985). This scale constant is inversely proportional to the variance of the error in the utility function in the logit model. Therefore, direct comparison of the parameters across different markets is not desirable because such comparisons are confounded by the error variances (Swait and Louviere 1993). However, it is possible to compare the ratio of the parameters across data sets, because the scale constant cancels out in the ratio of parameters.

We constructed five measures to test the expectations we previously discussed with respect to the reasons that may underlie the differential success of store brands in the United States and Europe.

Prior (initial) uncertainty. To compare the initial uncertainty levels associated with store brands and national brands, we define ratio r_1 as the ratio of the standard deviation of the prior perception of store brands to the standard deviation of the prior perception of national brands, such that $r_1 = \sigma_{A_s}/\sigma_{A_n}$, where σ_{A_s} is the standard deviation of the prior perception of store brands, and σ_{A_n} is the standard deviation of the prior perception of national brands. This variable captures the relative prior uncertainty associated with store brands and national brands. Note that σ_{A_s} may be higher than σ_{A_n} in all countries (and we can compare parameters directly within the data sets). However, for initial uncertainty levels associated with store brands to be *relatively* higher in the United States than in the United Kingdom and Spain to explain partially the differential success of store brands across the three counties, we need to obtain a value of r_1 that is larger in the United States than in the United Kingdom (and Spain), where store brands have higher market shares. Thus, a large r_1 in the United States and a small r_1 in the United Kingdom suggests that initial uncertainty levels associated with store brands compared with those associated with national brands are higher in the United States than in the United Kingdom. Thus, we expect

that r_1 is larger in the United States than in Europe, ceteris paribus.

Precision of information contained in use experience. To compare the precision of information contained in use experience (which is a function of both quality consistency over time and consumers' ability to evaluate quality from consumption occasion to consumption occasion) for store brands and national brands across countries, we need to compare the variance of the experience variabilities of store brands and national brands across the three countries. We define the ratio r_2 as the ratio of the experience variability of store brands to the experience variability of national brands, such that $r_2 = \sigma_{x_s}/\sigma_{x_n}$, where σ_{x_s} is the experience variability of store brands, and σ_{x_n} is the experience variability of national brands. A large r_2 (rather than a small one) indicates that the precision of information contained in store brands $(1/\sigma_{x_s})$ versus national brands $(1/\sigma_{x_n})$ is lower than it is for a small r_2. We note that in each country, the precision of information contained in use experience may be higher for national brands than for store brands. We expect that the value of r_2 is smaller in countries in which store brands have higher market shares, ceteris paribus.

Risk versus price sensitivity. We define the ratio r_3 as the ratio of consumers' mean risk-aversion level to their mean price sensitivity, such that $r_3 = \gamma_0/\alpha_0$, where γ_0 is the mean risk aversion, and α_0 is the mean price coefficient.

In a market in which the market shares of stores brands are higher, we expect that consumers are relatively more price sensitive than they are risk averse. Thus, we expect that the value of r_3 is lower in countries in which store brands have higher market shares, ceteris paribus.

Quality versus price sensitivity. We define the ratio r_4 as the ratio of consumers' mean quality weight to their mean price sensitivity, such that $r_4 = \omega_0/\alpha_0$, where w_0 is the mean quality weight, and α_0 is the mean price coefficient. In a market in which the market shares of stores brands are higher, we expect that consumers are less quality sensitive than they are price sensitive. Thus, we expect that the absolute value of r_4 is lower in countries in which store brands have higher market shares, ceteris paribus.

Quality differentials between store and national brands. Finally, we define the ratio r_5 as the ratio of the difference between the mean (perceived) quality level of the best national brand (i.e., the national brand with the highest mean quality) and the mean (perceived) quality level of the store brand to the mean (perceived) quality level of the best national brand. In a market in which store brands have higher market shares, we expect that the quality differences between store brands and national brands are smaller. Therefore, we expect that the value of r_5 is lower in countries in which store brands have higher market shares, ceteris paribus.

Testing with ratios. We use the five ratios to test whether the theoretical implications of the signaling theory and the theory of decision making under uncertainty partially explain the differences in store market shares in the United States relative to market shares in Spain and the United Kingdom. The more we determine that ratios are in the expected order in Spain and the United Kingdom than in the United States, the stronger evidence we have for our proposition that the theories partially explain differential store-brand performances. However, no single ratio is a necessary or sufficient condition for market shares to be larger or smaller in a country, because there are other factors, such as industry structure and retailer competition, that affect market shares as well, and it is beyond our scope to analyze these factors.

Identification

The first identification problem is that the addition of a constant to attribute levels leads to no uniqueness of the attribute-weight and risk-aversion parameters. A way to eliminate this identification problem is to require that

$$\sum_{j=1}^{J} A_j = 0, \tag{26}$$

where the set of J includes both the store and the national brands. This restriction is the same as Elrod's (1988) restriction to eliminate the translational invariance and as that in Erdem's (1998) umbrella-branding article.

The second identification problem is the scale invariance in Equation 19 (Erdem 1998). To remove this indeterminacy, we normalize the distribution of ω_i by imposing the following requirement:

$$\sigma_\omega = 1. \tag{27}$$

The final identification problem in the model is rotational invariance (Erdem 1996, 1998). A possible solution is to fix the direction of the utility weights vector and the risk-aversion parameters as follows:

$$\omega_i \sim N(\omega_0, 1), \text{ and } \rho_i \sim N\left(\rho_0, \sigma_\rho^2\right). \tag{28}$$

Model Estimation

We denote the log-likelihood function for the observation period T by LogL(θ).

$$\text{LogL}(\theta) = \sum_{i=1}^{I} \ln L_i(\theta). \tag{29}$$

We estimate the model by using simulated maximum likelihood because the discrete-choice probabilities needed to construct the likelihood functions are high-order integrals over the random variables (e.g., Hajivassiliou and Ruud 1994; Keane 1993; McFadden 1989). Equation 29 can be rewritten as follows:

$$\text{LogL}(\theta) = \sum_{i=1}^{I} \tilde{L}_i(\theta), \tag{30}$$

where

$$\tilde{L}_i(\theta) = \frac{1}{N}\sum_{r=1}^{N}\prod_{t=1}^{T}\prod_{j=1}^{J} q_{ijt}(A|\upsilon_{ir})^{D_{ijt}}, \tag{31}$$

where υ_{ir}, r = 1, 2, ..., N are random vectors drawn from the distribution of υ_i, and N is the number of draws (which we set to 100 in the estimation). The quasi-Newton method with line search maximizes the log-likelihood function. We use Berndt and colleagues' (1974) algorithm to approximate the Hessian.

The parameters to be estimated are as follows: (1) mean price coefficient α_0 and standard deviation of the price coefficient σ_α, (2) mean utility weight ω_0 (note that to solve the

identification problem, we restrict the standard deviation of the utility weight to one), (3) mean risk-aversion coefficient γ_0 and standard deviation of the risk-aversion coefficient σ_γ, (4) standard deviation of the prior perceptions of the national-brands σ_{A_n} and standard deviation of the prior perceptions of the store-brands σ_{A_s}, (5) standard deviation of the experience variabilities for national-brands σ_{x_n} and standard deviation of the experience variabilities for store-brands σ_{x_s}, and (6) the estimations of the mean quality levels A_j, $j = 1, 2, ..., J$.

DATA

We estimated the models with scanner-panel data on laundry detergent across three countries (the United States, the United Kingdom, and Spain), supplied by ACNielsen. We also estimated the models on toilet paper and margarine in the United States and Spain. Store-brand market shares in detergent in Spain and the United Kingdom are high, at approximately 38% in Spain and 29% in the United Kingdom, compared with 4% in the United States. Similarly, the store-brand shares in toilet paper and margarine in Spain (40% and 22%, respectively) are higher than the store-brand shares in the same categories in the United States (14% and 8%, respectively).

We chose detergent as the main category to analyze because previous work has shown that uncertainty exists in this category (e.g., Erdem and Keane 1996).[6] Ideally, it would be better to choose a category in which the number of brands in the category and concentration in the category are similar across the countries studied, because we studied the impact of uncertainty-related factors and consumer attitudes toward risk, price, and quality on market shares, ceteris paribus. Indeed, the number of top national brands in the category across the three countries is similar (6 national brands in the United States and Spain and 5 national brands in the United Kingdom, in combination with store brands, constitute 70%–80% of the market in each country). In addition, the total number of store brands is similar across the three countries (21 in the United States, 20 in the United Kingdom, and 18 in Spain). We note that the retail concentration index in the grocery industry in the United Kingdom and Spain is not substantially different from that in the United States (United Kingdom: 69%, Spain: 60%, and United States: 51%; for the U.K index, see Euromonitor 1998; for the Spain index, see *Distribución y Actualidad* 2000; for the U.S. index, see *Beverage World* 2000).

However, we also had data on toilet paper and margarine in the United States and Spain, and we estimated the model on these data sets to provide some generalizability across product categories. In the toilet paper (margarine) product category, the number of top national brands is 5 (6) and 3 (4) in the United States and Spain, respectively.

The data sets include households' daily purchase activities and the price information in each market. In the U.S. market, 110 stores and 314 households are included in the data set. The purchase activities are recorded from December 1997 to December 1999. The U.S. panel includes purchases of households in Atlanta and Chicago. The U.K. data set includes 214 households and 176 stores, and the date range is from January 1998 to December 1999. The Spain data set includes 84 stores and 167 households, and the time period is from January 1998 to February 2000. Both the U.K. and Spain data sets include households across the country rather than households in specific cities.[7]

In any ratios that involve the price coefficient, it is necessary that the utility be expressed in the same monetary units to ensure comparability across counties. To express prices (and thus utility) in common monetary units (US$), we used the mean exchange rate during the period of analysis to convert each individual purchase price in the data from the United Kingdom and Spain into dollar prices. To do so, we collected monthly exchange-rate data for the period of the analysis, and we calculated one mean exchange rate for each country. The exchange rate we used for the United Kingdom was 1.638 (£1 = US$1.638), and that used for Spain was .006 (PTA 1 = US$.006). We also calculated the standard deviations of the monthly exchange rates to determine whether there had been large fluctuations during the period for our scanner-panel data sets, but standard deviations were low (in the case of £/US$ rates, it was .028; in the case of PTA/US$ rates, it was .00052).

In all three markets, we lumped together the store brands as the "store brand," which implies that the generalizability of the results hinges on the assumption that the variance across different store brands in a given country does not alter the results we obtained significantly. However, to test the robustness of our results to this manipulation, we estimated a model in which we included only the top two store brands (the two store brands with the highest market shares) in the analysis; we also estimated separate mean quality parameters for each. The results were not sensitive to the alternative specification of store brands. We note that this manipulation constitutes a conservative test, because we expect that the differences between national and store brands are even bigger for lower-share store brands.

In the detergent category, we selected six national brands and the store brand that account for 70% of the market share for the model estimation in the United States and Spain. In the U.K. market, we selected five national brands and the store brand that account for 80% of the market share for the model estimation. In the toilet paper and margarine data sets, the brands under analysis captured more than 90% of the total market share in each country. Tables 1, 2, and 3 report the markets shares and average prices paid (coupons excluded) in our samples in each product category.

We also note that whereas previous research has shown that most frequently purchased consumer packaged goods (e.g., detergents, toothbrushes) are subject to uncertainty (e.g., Erdem 1998), our model enables us to test whether there is uncertainty in these markets. If the prior variance of the quality level of national brands (σ_{A_n}) and/or of store brands (σ_{A_s}) were statistically insignificant, this would suggest the absence of uncertainty.

EMPIRICAL RESULTS AND DISCUSSION

The purpose of this article is to test whether uncertainty and uncertainty-related consumer processes, as well as consumer risk, price, and quality attitudes, play a role in

[6]Quality uncertainty has been demonstrated in many other frequently purchased product categories, including toothpaste, toothbrushes (Erdem 1998), and yogurt (Ackerberg 2000).

[7]ACNielsen provided the data by randomly drawing from its larger panel sets. Thus, the data sets on which we estimate our model constitute a subset of ACNielsen's panel data.

Table 1
MARKET SHARES AND AVERAGE PRICES IN THE DETERGENT CATEGORY

	Market Share	*Average Price*
United States		
HD	11.9	404.6
All	13.3	470.5
Purex	11.6	345.4
Surf	10.6	563.8
Tide	35.7	724.4
Wisk	13.1	566.3
Store label	3.6	335.7
Spain		
Ariel	19.5	860.0
Dixan	7.0	702.2
Elena	7.2	617.9
Puntomatic	10.3	135.5
Skip	9.4	801.4
Store label	35.8	371.9
Wipp	10.9	842.3
United Kingdom		
Ariel	18.6	347.6
Bold	13.6	293.1
Daz	10.5	271.9
Persil	20.1	357.6
Store label	28.5	226.3
Surf	8.7	239.4

Notes: Average prices are in dollars, pesetas, and pounds for the United States, Spain, and the United Kingdom, respectively.

Table 2
MARKET SHARES AND AVERAGE PRICES IN THE TOILET PAPER CATEGORY

	Market Share	*Average Price*
United States		
Angel Soft	17.1	226.8
Charmin	28.4	369.7
Kleenex	15.0	310.9
Northern	14.6	405.7
Scott	10.8	307.4
Store brand	14.1	150.9
Spain		
Colhogar	21.7	309.1
PP	9.0	256.2
Scottex	30.7	452.3
Store label	44.0	282.3

Notes: Average prices are in dollars and pesetas for the United States and Spain, respectively.

Table 3
MARKET SHARES AND AVERAGE PRICES IN THE MARGARINE CATEGORY

	Market Share	*Average Price*
United States		
Blue Bonnet	15.5	66.1
I Can't Believe It's Not Butter	20.5	144.7
Imperial	14.8	72.4
Land O'Lakes	11.1	128.2
Parkay	11.8	125.8
Shedd	18.4	144.7
Store brand	7.9	86.2
Spain		
Artua	22.5	200.7
Flora	16.8	189.9
Ligeresa	8.2	145.5
Tulipán	30.6	176.2
Store label	21.9	107.7

Notes: Average prices are in dollars and pesetas for the United States and Spain, respectively.

explaining differences in market shares in the United States and Europe. This can be done only if an explicit model of uncertainty is formulated and estimated. Thus, the estimation of competing models is not our objective. However, to obtain a sense of model fit, we estimated two models to compare in-sample fits. Other than our full model, we estimated two different models by setting the risk parameter in Equation 17 to zero ($\gamma = 0$) and not allowing for any Bayesian updating. This model became the static heterogeneous logit model, which is nested in our full model. We estimated a second comparison model, in which we added "dynamic" to the first comparison model with the static heterogeneous logit specification in a reduced-form way. More specifically, using Guadagni and Little's (1983) exponential smoothing specification, we added a variable on weighted average of previous purchases to the first comparison model to capture the impact of previous purchases (purchase feedback) on choices. This model is not nested in our full model, but it nests the first comparison model. Thus, the second comparison model is the well-known heterogeneous logit specification with state dependence (for a review, see Keane 1997).

Table 4 reports the log-likelihoods and Bayesian information criteria (BIC) for Spain, the United Kingdom, and the United States, in the detergent category. (Tables 5 and 6 report these statistics for toilet paper and margarine, respec-

Table 4
FIT STATISTICS FOR DETERGENT BY COUNTRY

	Static Heterogeneous Logit Model	*Heterogeneous Logit Model with Purchase Feedback*	*Heterogenous Logit with Updating (Full Model)*
Spain			
Log-likelihood	–21,909.69	–21,847.26	–21,753.16
BIC	–21,897.73	–21,840.88	–21,733.2
United Kingdom			
Log-likelihood	–19,884.26	–19,720.05	–19,410.50
BIC	–19,867.30	–19,696.72	–19,380.81
United States			
Log-likelihood	–11,574.11	–11,029.14	–10,625.58
BIC	–11,556.86	–11,006.14	–10,596.83

Table 5
FIT STATISTICS FOR TOILET PAPER BY COUNTRY

	Static Heterogeneous Logit Model	*Heterogeneous Logit Model with Purchase Feedback*	*Heterogenous Logit with Updating (Full Model)*
Spain			
Log-likelihood	–13,819.78	–11,743.37	–10,620.76
BIC	–13,788.30	–11,715.64	–10,583.78
United States			
Log-likelihood	–12,331.49	–11,719.55	–10,285.65
BIC	–1288.92	–11,661.01	–10,211.15

Table 6
FIT STATISTICS FOR MARGARINE BY COUNTRY

	Static Heterogeneous Logit Model	*Heterogeneous Logit Model with Purchase Feedback*	*Heterogenous Logit with Updating (Full Model)*
Spain			
Log-likelihood	–13,420.26	–12,875.21	–12,103.42
BIC	–13,384.38	–12,926.47	–12,036.78
United States			
Log-likelihood	–11,207.32	–10,308.41	–9795.19
BIC	–11,163.75	–10,250.32	–9722.58

tively.) In all countries and categories, the addition of previous purchases to the static heterogeneous logit formulation improves fit in a statistically significant way. The second comparison model and our model are nested, but the BIC historically has been used in these settings and suggests that our full model indeed fits better.

The parameter estimates in all the three categories (presented in Tables 7–9) have the correct signs and are statistically significant in all the countries, except for both the experience variability parameter for store brands in the detergent category and the risk parameter in the margarine category in Spain. In all countries, price has a negative effect on utility, whereas perceived quality has a positive effect on utility. The risk coefficients, γ_0, are negative. This result, combined with a positive mean utility weight, ω_0, suggests that consumers are risk averse: The increased perceived quality variance (perceived risk) decreases consumers' expected utility and lowers brand-choice probability, in all countries and product categories, except for the margarine category in Spain, for which the risk coefficient is negative but statistically nonsignificant.

The statistically significant prior variances of consumer quality perceptions in all the countries and product categories show that there is consumer uncertainty about quality in these markets (Tables 10–12). The experience variabilities for national brands are statistically significant in all countries and categories. The experience variabilities for store brands are statistically significant, except for the detergent category in Spain, which indicates that use experience provides only noisy information.

Table 7
PARAMETER ESTIMATES FOR THE DETERGENT CATEGORY

Parameter Estimates	*Spain*	*United Kingdom*	*United States*
Mean price sensitivity α_0	–.238	–.040	–.021
	(.006)	(.002)	(.003)
Standard deviation of price sensitivity σ_α	.266	.134	.060
	(.007)	(.003)	(.003)
Mean utility (quality) weight ω_0	.159	.027	.023
	(.013)	(.005)	(.012)
Mean risk aversion γ_0	–.275	–3.000	–5.475
	(.033)	(.512)	(2.468)
Standard deviation of risk aversion σ_γ	.068	.868	2.524
	(.023)	(.313)	(1.315)
Prior standard deviation of quality perceptions (national brands) σ^2_{An}	.627	.532	.420
	(.010)	(.010)	(.079)
Prior standard deviation of quality perceptions (store brands) σ^2_{As}	.356	.529	3.448
	(.058)	(.024)	(.241)
Experience variability for national brands (reported as standard deviation; i.e, square root of experience variability) σ^2_{xn}	1.337	.946	1.238
	(.081)	(.040)	(.658)
Experience variability for store brands (reported as standard deviation; i.e, square root of experience variability) σ^2_{xs}	.124	1.660	4.791
	(.140)	(.145)	(.406)

Table 8
PARAMETER ESTIMATES FOR THE TOILET PAPER CATEGORY

Parameter Estimates	*Spain*	*United States*
Mean price sensitivity α_0	−.140	−.006
	(.005)	(.001)
Standard deviation of price sensitivity σ_α	.192	.039
	(.005)	(.001)
Mean utility (quality) weight ω_0	.066	.248
	(.003)	(.013)
Mean risk aversion γ_0	−4.922	−.148
	(.109)	(.011)
Standard deviation of risk aversion σ_γ	1.823	.465
	(.048)	(.039)
Prior standard deviation of quality perceptions (national brands) σ^2_{An}	1.401	4.010
	(.037)	(.129)
Prior standard deviation of quality perceptions (store brands) σ^2_{As}	1.592	9.939
	(.058)	(.388)
Experience variability for national brands (reported as standard deviation, i.e, square root of experience variability) σ^2_{xn}	1.298	.809
	(.066)	(.128)
Experience variability for store brands (reported as standard deviation, i.e, square root of experience variability) σ^2_{xs}	.953	1.559
	(.108)	(.637)
Log-likelihood	−10,620.76	−10,285.65

Table 9
PARAMETER ESTIMATES FOR THE MARGARINE CATEGORY

Parameter Estimates	*Spain*	*United States*
Mean price sensitivity α_0	−.040	−.021
	(.005)	(.001)
Standard deviation of price sensitivity σ_α	.140	.073
	(.006)	(.003)
Mean utility (quality) weight ω_0	.050	.012
	(.039)	(.008)
Mean risk aversion γ_0	−2.000	−4.731
	(1.566)	(3.130)
Standard deviation of risk aversion σ_γ	.000	1.589
	(1.683)	(2.423)
Prior standard deviation of quality perceptions (national brands) σ^2_{An}	.540	.638
	(.064)	(.051)
Prior standard deviation of quality perceptions (store brands) σ^2_{As}	.530	.784
	(.092)	(.126)
Experience variability for national brands (reported as standard deviation; i.e, square root of experience variability) σ^2_{xn}	.500	.445
	(.161)	(.106)
Experience variability for store brands (reported as standard deviation; i.e, square root of experience variability) σ^2_{xs}	.500	.865
	(.221)	(.354)
Log-likelihood	−12,103.42	−9795.19

The results also show that the prior standard deviation of quality perceptions of national brands is much smaller than the standard deviation of quality perceptions of U.S. store brands (e.g., in the detergent category, $\sigma_{A_n} = .420$, $\sigma_{A_s} = 3.448$); they are about the same in the United Kingdom. In Spain, the standard deviation of quality perceptions of store brands is indeed smaller than that of national brands in the detergent and margarine categories, and the standard deviation of quality perceptions of store brands is larger than that of national brands in the toilet paper category. Thus, prior uncertainty about store brands rather than national brands is much higher in the United States in all categories, about the same in the United Kingdom (for detergent, because we have U.K. data on detergent only), and higher for national brands in Spain, except for the toilet paper category.

In all three product categories, experience variabilities are consistently higher for store brands than for national brands in the United States. The same holds for the detergent category in the United Kingdom, which suggests that consumers believe that the quality levels of national brands are more consistent than those of store brands. The result is consistent with the belief in the United States that, in general, national brands deliver more consistent quality levels than do store brands. In Spain, where the market shares of store brands are high, the experience variabilities of national and store brands are the same in the margarine category, but experience variabilities of store brands are lower than those of national brands in the detergent and toilet paper categories.

Given the purposes of our study, the important results are associated with the five ratios we discussed before. Table 13 reports these five ratios across the three countries in the detergent category. Tables 14 and 15 report the ratios for toilet paper and margarine, respectively, in the United States and Spain. Recall that we expect the ratios to be higher (in absolute value), ceteris paribus, for countries in which store-brand market shares are lower because of higher uncertainty

Table 10
ESTIMATES OF THE MEAN QUALITY (LATENT ATTRIBUTE) LEVELS FOR DETERGENT

	Estimates
Spain	
A_{Ariel}	−.989
	(.031)
A_{Dixian}	−.323
	(.034)
A_{Elena}	−.163
	(.037)
$A_{Puntomatic}$	.530
	(.027)
A_{Skip}	−.220
	(.030)
A_{Wipp}	−1.266
	—
$A_{Store\ Brand}$	−.102
	(.028)
United Kingdom	
A_{Ariel}	−.251
	(.058)
A_{Bold}	−.249
	(.058)
A_{Daz}	−.167
	(.056)
A_{Persil}	−.203
	(.057)
A_{Surf}	1.124
	—
$A_{Store\ Brand}$	−.254
	(.059)
United States	
$A_{Arm\ \&\ Hammer}$	−.243
	(.141)
A_{All}	−.158
	(.139)
A_{Purex}	−.278
	(.135)
A_{Surf}	−.795
	(.132)
A_{Tide}	2.279
	—
A_{Wisk}	−.246
	(.144)
$A_{Store\ Brand}$	−.559
	(.170)

Table 11
ESTIMATES OF THE MEAN QUALITY (LATENT ATTRIBUTE) LEVELS FOR TOILET PAPER

	Estimates
Spain	
$A_{Colhogar}$	.011
	(.058)
A_{PP}	2.041
	(.037)
$A_{Scottex}$	−3.098
	—
$A_{Store\ Brand}$	1.046
	(.038)
United States	
$A_{Angel\ Soft}$	−1.478
	(.104)
$A_{Charmin}$	1.630
	(.089)
$A_{Kleenex}$	1.305
	—
$A_{Northern}$	−.660
	(.110)
A_{Scott}	−.659
	(.112)
$A_{Store\ Brand}$	−.138
	(.186)

Table 12
ESTIMATES OF THE MEAN QUALITY (LATENT ATTRIBUTE) LEVELS FOR MARGARINE

	Estimates
Spain	
A_{Artua}	.500
	(.036)
A_{Flora}	−.980
	(.051)
$A_{Ligeresa}$	1.580
	(.061)
$A_{Store\ Brand}$	−.840
	—
$A_{Tulipán}$	−.260
	(.067)
United States	
$A_{Blue\ Bonnet}$	.360
	(.267)
$A_{I\ Can't\ Believe\ It's\ Not\ Butter}$	−.706
	(.278)
$A_{Imperial}$	1.419
	(.276)
$A_{Land\ O'Lakes}$	−.055
	(.265)
A_{Parkay}	−.013
	(.267)
A_{Shedd}	−.965
	—
$A_{Store\ Brand}$	−.040
	(.259)

associated with store brands (higher prior uncertainty and higher experience variabilities) and because of higher risk and quality sensitivities and lower price sensitivities. We note the ceteris paribus nature of our expectations: Although the more ratios that turn out to reveal the expected pattern across countries, the stronger evidence we have for consumer uncertainty–related drivers behind different market shares of store brands across countries, not all ratios reveal the same pattern. For example, in a specific category and country, the prior uncertainty of store brands may be relatively low (suggesting a high market share for store brands, ceteris paribus), but the quality differentials between national and store brands may be large and consumers may be quality sensitive (suggesting a low market share for store brands, ceteris paribus). The latter effect may dominate the former, leading to a low observed market share for store brands in that particular market.

We now discuss the detergent results in detail and briefly summarize the margarine and toilet paper results, which are consistent with the results we obtained in the detergent category. The ratios reported in Table 13 strongly support the notion that consumer learning and perceived risk play an important role in consumers' store-brand and national-brand choices. The r_1 estimates, which are the ratios of the prior standard deviation of quality perceptions of store brands to that of national brands, show that the United States has the

Table 13
RATIOS OF PARAMETER ESTIMATES FOR CROSS-COUNTRY COMPARISONS (DETERGENT)

Parameter Estimates	*Spain*	*United Kingdom*	*United States*
r_1	.568	.994	8.202
r_2	.093	1.755	3.870
r_3	1.155	75.000	260.342
r_4	−.668	−.675	−1.095
r_5	1.081	1.226	1.245

Table 14
RATIOS OF PARAMETER ESTIMATES FOR CROSS-COUNTRY COMPARISONS (TOILET PAPER)

Parameter Estimates	*Spain*	*United States*
r_1	.734	1.927
r_2	1.136	2.478
r_3	35.132	24.667
r_4	−.488	−1.085
r_5	.471	41.333

Table 15
RATIOS OF PARAMETER ESTIMATES FOR CROSS-COUNTRY COMPARISONS (MARGARINE)

Parameter Estimates	*Spain*	*United States*
r_1	1.000	1.944
r_2	.981	1.230
r_3	50	224.112
r_4	−1.532	−1.028
r_5	.001	.571

highest ratio (8.202), followed by much lower ratios in the United Kingdom (.994) and Spain (.568). Thus, the United States, which has a much lower market share of store brands than do the United Kingdom and Spain, is also the country in which initial uncertainty about quality is much higher for store brands than for national brands. In the United Kingdom, the uncertainty is about the same for national and store brands, whereas in Spain, consumers seem to be rather certain about the quality levels of store brands (note that the consumers may believe that store brands are indeed of low quality; lack of uncertainty does not indicate high quality, it just means that consumers believe that they know what the quality levels are).

The figures for r_2, which is the ratio of the standard deviation of the experience variabilities of store brands to that of national brands across the three countries, show that the United States has the largest ratio ($r_2 = 3.870$), followed by the United Kingdom ($r_2 = 1.755$) and Spain ($r_2 = .093$). Thus, store brands in the United Kingdom and Spain deliver more consistent quality levels over time than do store brands in the United States; therefore, risk-averse consumers are more likely to choose national brands because of the lower risk associated with purchase of the national brands in the United States.

The ratio of risk aversion to price sensitivity, r_3, is highest in the United States (260.342) and lowest in Spain (1.155). Thus, U.S. consumers seem to be relatively more risk averse than price sensitive compared with both their Spanish and their U.K. counterparts.

The absolute value of the ratio of mean quality weight to price sensitivity, r_4, is highest in the United States (1.095) and lowest in Spain (.668). Thus, U.S. consumers seem to be relatively more quality sensitive than price sensitive compared with Spanish consumers.

Finally, to compare the relative quality level of store brands and national brands, we need to examine r_5, which reflects the perceived quality differences between national and store brands. The larger this ratio is, the larger are the differences. The perceived differences seem to be highest in the United States and lowest in Spain, but the differences across countries seem to be much smaller than in the first three ratios.

To summarize the results, the United States seems to be subject to more initial quality uncertainty associated with store brands and has less consistent store-brand quality levels over time. Consumers in the United States are also relatively more risk averse than price sensitive than are consumers in both the United Kingdom and Spain. They are also relatively more quality sensitive than price sensitive than Spanish consumers. In the United States, there are higher perceived quality differences between national and store brands than in the United Kingdom and Spain. However, the differences between the United States and both the United Kingdom and Spain are highest for the first three ratios, which reflect uncertainty-related mechanisms. Thus, differential uncertainty associated with store brands, differences in quality consistency over time, and differences in relative risk behavior seem to drive the differential market shares of U.S. store brands over U.K. and Spanish store brands, as we hypothesized.

The results we obtained in the toilet paper and margarine categories for the United States and Spain are consistent with the detergent results and provide further evidence for quality uncertainty–related reasons that affect the differential success of store brands in the United States and Europe. All the ratios reveal the expected patterns in both categories, except for the ratio of risk aversion to price sensitivity, r_3, in the toilet paper category and the absolute value of the ratio of mean quality weight to price sensitivity, r_4, in the margarine category. This suggests that in the toilet paper category, U.S. consumers are relatively more price sensitive than risk averse than are their Spanish counterparts; in the margarine category, U.S. consumers are relatively more price sensitive than quality sensitive than are their Spanish counterparts. This result seems to have face validity because in Spain the margarine category is known as one in which consumers are quality sensitive, because margarine is mainly used as a spread rather than for cooking purposes. Overall, our findings are encouraging in terms of the generalizability of our results to other frequently purchased consumer packaged goods.

CONCLUSION

We empirically studied consumer choice behavior with respect to store brands in the United States, the United Kingdom, and Spain in the detergent category and in the United States and Spain in the toilet paper and margarine cate-

gories. We estimated a model of consumer brand choice in an environment in which consumers are uncertain about brand attributes, which may create consumer perceived risk. In the model, use experience gives consumers noisy signals about brand attributes; we derived the functional form for the experience effect from the Bayesian learning framework. In this framework, store brands will be relatively more successful if (1) consumers' prior uncertainty about them is relatively low (e.g., because of consistent communication messages in the past); (2) a product delivers consistent attribute levels over time, making use experience a more diagnostic source of information about quality levels; and (3) consumers are relatively more price sensitive, less quality sensitive, and less risk averse, ceteris paribus. Our main objective was to analyze whether these factors play a role in explaining the differential success of U.S. and European store brands.

We used scanner-panel data on detergent from the United States, the United Kingdom, and Spain and on toilet paper and margarine from the United States and Spain to estimate the model and to compare consumer behavior with respect to store brands across the three countries. We found strong evidence for consumer learning about quality; consumer quality expectations; perceived risk; and consumer preferences for price, quality, and risk to explain consumer brand choices. Our results establish that differences in store brands' equity contribute to differences in the brands' strength across the three countries we studied.

We found that in the laundry detergent category, store brands in the U.K. and Spanish markets have less quality uncertainty associated with them, and they deliver more consistent positioning and quality levels over time than do the store brands in the U.S. market. We note that consistent positioning of store brands in the United Kingdom and Spain does not mean that the positioning strategies in these two countries were similar, per se. In the United Kingdom, in general, store brands have a history of consistent "quality" positioning that is sustained by extensive investing in store brands, whereas in Spain, store brands were introduced and marketed consistently as cheap no-frills alternatives to national brands (Ryan 1995). Thus, although in Spain and the United Kingdom store brands provide more consistent positioning over time than they do in the United States, the positioning strategies themselves can be different in the United Kingdom from those in Spain. Given our results, which suggest that consumers are more price sensitive and/or less quality sensitive in Spain than in the United Kingdom, the positioning strategies seem sensible. Finally, we found that consumers in the United Kingdom and Spain are relatively more price sensitive than quality sensitive and risk averse than are consumers in the United States. This at least partially explains why store brands in the United Kingdom and Spain perform better than store brands in the United States. The results from the toilet paper and margarine categories were largely consistent with results obtained from the detergent category.

Our results indicate that consistent quality levels and positioning, as well as a reduction of the gap between the perceived quality levels of national and store brands, would help store brands, ceteris paribus. Nevertheless, given the cost considerations, the optimal marketing strategy depends on consumer price, quality, and risk sensitivities in each country and the product category. For example, when consumers are price sensitive and relatively quality insensitive, store brands would perform better if they attempt not to reduce quality differentials between store and national brands but to reduce prior uncertainty about quality through consistent quality and positioning and differentiating the brand as a basic, no-frills option rather than attempting to "imitate" leading national brands. However, when consumers are more quality sensitive than price sensitive, a consistent positioning that differentiates the store brand as a high (or even higher) quality alternative to the national brand (e.g., Marks & Spencer in the United Kingdom, El Corte Inglés in Spain) would work better.

There are a few venues for further research. First, the impact of other marketing-mix elements (e.g., advertising) on consumer learning, perceived risk formation, and the like could be explicitly studied to analyze the differential success of store brands across countries. Second, subject to data availability, the analysis could be repeated for nonpackaged consumer goods categories. Third, the study could be expanded to more countries to draw some empirical generalizations. Fourth, survey research could be conducted to investigate differences and similarities across both countries and product categories to determine the elements of consistency in positioning (e.g., consistency in packaging versus consistency in advertising) to which consumers are sensitive in the formation of their quality and risk beliefs about national and store brands.

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