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Who Benefits from Store Brand Entry?

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Store brand entry has become a key issue in marketing as it may structurally change the performance of and the interactions among all market players. Based on their multivariate time-series analysis, the authors demonstrate permanent performance effects of store brand entry, typically benefiting the retailer, the consumers, and premium-brand manufacturers, while harming second-tier brand manufacturers. For the *retailer*, they consistently find two *beneficial effects* of store brand entry: *high unit margins on the store brand itself and higher unit margins on the national brands*. This increase in unit margins implies that the retailer strengthens its bargaining position vis-à-vis national brand manufacturers. However, store brand entry only rarely yields category expansion and does not create store traffic or revenue benefits. Second, *consumers* do not obtain lower prices on all national brands, only on some second-tier brands. However, they benefit from enlarged product assortment and intensified promotional activity that lowers average price paid for two out of four categories. For the *manufacturers*, store brand entry is typically beneficial for *premium-price* national brands, but not for *second-tier* national brands. Often, premium brands experience lower long-term price sensitivity and higher revenues, whereas second-tier brands experience higher long-term price sensitivity and lower revenues.

Key words: structural change; manufacturers versus retailers; store brand entry; unit root tests; vector-autoregressive models; long-term price elasticity
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1. Introduction

Store brands, also known as private labels, have enjoyed increased attention in recent years. In the 2001 *Progressive Grocer* annual survey, retailers rated higher store brand focus as their "most likely action," before efficient assortment and category management. Currently, store brands are the share leaders in about 20% of all food categories, accounting for at least 20% of total store sales in the United States and Europe (Hoch 1996, Steenkamp and Dekimpe 1997). Moreover, revenues from store brands are expected to grow to an average of 23.9% of total retailer revenues (Kurt Salmon Associates 1998). In this context, researchers and managers alike underscore the importance of store brand entry in a category. From a strategic perspective, three sets of players are affected by store brand entry and interact to create its net impact: (i) the retailer, (ii) the manufacturers, and (iii) the consumers.

For the *retailer*, store brands are the only brands that require taking full responsibility for product introduction, product sourcing and warehousing, advertising, and promotions (Dhar and Hoch 1997). In contrast to the shared risks and returns for national brands, the retailer plays a critical role in the success of the store brand. Moreover, the entry of a store brand changes the retailer-national brand manufacturer interaction from one of cooperation to one of competition for consumer dollars. As retailer performance is linked to all the brands in the category (Raju 1992), this new competitive environment may induce reconsideration of consumer prices for all brands. Finally, entry of the store brand may have store-traffic implications for the retailer (Walters and Rinne 1986). The relevant question for retailers, then, is what is the impact of store brand entry on category and store performance?

For the national brand *manufacturers*, the new competitive element in the manufacturer-retailer relationship may change the strategic interaction between the two parties. For example, the incumbent national brand manufacturer may respond to store brand entry with changes in regular prices (Hauser and Shugan 1983) and with changes in price promotions (Lal 1990, Quelch and Harding 1996). If store brand and national brand promotions attract the same consumers, intensified competitive reactions could emerge in a battle for market share between manufacturers and retailers. The relevant questions, then, are how national brand manufacturers are affected by store brand entry and how they respond to the new competitive environment.

The responses of *consumers* define the demand side. For one, the introduction of a new product such as

a store brand may increase primary demand, creating room for win-win scenarios among entrant and incumbent brands (Hauser and Shugan 1983). Alternatively, store brand entry may result in brand switching, drawing buyers away from the existing brands (Dekimpe et al. 1997). Moreover, long-term price sensitivity may change due to the different competitive market structure in the pre- and postentry periods, and the direction of this change may depend on the incumbent brand's position. From a consumer benefits perspective, relevant questions are whether the entry of a store brand increases consumer choice (category product assortment) and whether it lowers retail prices.

While multiple papers have studied the motivation for store brand entry (see Scott-Morton and Zettelmeyer 2001), the strategic positioning of store brands (Sayman et al. 2002, Scott-Morton and Zettelmeyer 2001), the market success of the store brand itself (Raju et al. 1995, Dhar and Hoch 1997), and the impact of store brands on retailer profitability (Ailawadi and Harlam 2002, Kadiyali et al. 2000), there is only limited research on the impact of store brand entry for the market players. A notable exception is Chintagunta et al. (2002), who assess the effect of store brand introduction on (1) the retailer in terms of national brand margins and category sales, (2) the manufacturer of the dominant brand(s) in terms of wholesale prices and competitive intensity, and (3) the consumer in terms of (short-term) price elasticities and equilibrium prices. They find that store brand introduction increases national brand margins for the retailer and increases consumer price sensitivity for the dominant brands. Several questions remain, however. First, are these effects of store brand entry permanent or temporary (Dekimpe and Hanssens 1995)? Second, does the increased price sensitivity and equilibrium price changes generalize to all national brands in the category, or does it depend on their positioning (Gruca et al. 2001)? Third, do retailer benefits extend to overall category and store performance? Finally, which of the store brand effects generalize (e.g., to nonfood categories) and which are category specific?

Our study addresses these questions as follows. First, we take a dynamic approach that assesses whether the beneficial (damaging effects) of store brand entry are permanent or temporary. While promotional activity by existing brands creates at best temporary benefits, new product introduction is likely to create a permanent impact and lead to a new dynamic competitive equilibrium (Bronnenberg et al. 2000, Nijs et al. 2001). A primary contribution of our study, therefore, is to focus on the *dynamic* impact of store brand entry on manufacturers, retailers, and consumers, and to test whether store brand entry has created such a permanent impact on performance variables by comparing the multivariate equilibrium in the pre- and postentry period. For each period, we also examine the long-term price response of brand and category performance (Pauwels et al. 2002, Srinivasan et al. 2001). Consequently, our approach is complementary to the structural, short-term model of Chintagunta et al. (2002) because we use a dynamic-systems model to assess the long-term impact of store brand entry on the three market players—retailers, national brand manufacturers, and consumers. Second, we expand our discussion to all brands in the category and investigate whether their (price tier) positioning affects changes in long-term price sensitivity, equilibrium prices, and ultimately manufacturer revenue. Third, we test for changes in retailer gross category margin, store traffic, and store revenue. Finally, we analyze four categories (one food and three nonfood products) that experience store brand entry in our dataset, in the spirit of exploratory replication and wider validation of our findings (Ailawadi 2001).

In summary, the introduction of a store brand may impact the performance of and the response from the retailer, the manufacturers, and the consumers and may have temporary or permanent effects, which may well vary across brands and categories. To answer these questions, we conduct an econometric investigation in the four product categories in our retailer dataset that feature store brand entry, such that we have several years of weekly time-series data before and after the introduction. For the retailer, we consider five performance variables: (i) category sales, (ii) category revenue, (iii) category margin, (iv) store traffic, and (v) overall store revenues. Manufacturer performance variables include (volume) sales and manufacturer revenues. For the consumer, we assess the impact of store brand entry on price levels and product assortment. Finally, we estimate and contrast long-term price sensitivity in the pre- and postentry period.

The paper is organized as follows. In §2, we review literature on the impact of store brand entry for all three parties. Next, in §3, we describe the testing framework for structural break analysis, the vector autoregressive model with exogenous variables (VARX), and their associated impulse response functions. In §4, we give a description of the retailer dataset covering seven years of weekly price and product activity in a regional market for the four categories—hot breakfast cereal, toothbrushes, paper towels, and soap. In §5, we report and interpret the results, and we present the conclusions in §6.

2. Background on the Introduction of Store Brands

The focus of this study is on understanding the impact of store brand entry for all three market play-

ers. Therefore, we review the existing literature for the retailer, for the manufacturers, and for the consumers. Table 1 summarizes our hypotheses.

2.1. Impact of Store Brand Entry for the Retailer

Store brand entry may benefit the retailer in several ways, all of which represent reasons to become a player in the category. First, store brand entry can enable retailers to strengthen their bargaining position vis-à-vis national brand manufacturers (Narasimhan and Wilcox 1998). In general, the channel power of the retailer is believed to increase as a result of store brand entry, which changes the nature of manufacturer-retailer interaction (Hoch and Banerji 1993, Raju et al. 1995, Hoch 1996). Specifically, store brands may allow the retailer to negotiate lower wholesale prices on national brands (Mills 1995). Moreover, retailers can strategically position store brands in the product space to strengthen their bargaining position when negotiating supply terms with manufacturers of national brands (Scott-Morton and Zettelmeyer 2001).

A second benefit of, and motivation for, store brand entry is category expansion. If the store brand is more attractive than the best incumbent brand for certain shoppers, store brand entry may increase category value and thus expand category sales (Mason 1990). Moreover, store brand entry may shake up a "dormant" category (Hauser and Shugan 1983). Competitive reactions of incumbent brands include price reductions and higher promotional activity, which could in turn stimulate primary demand.

Third, the store brand itself may generate profits because of its high unit margin and potentially high volume. As for the former, store brands typically carry higher retailer margins than national brands do, even after accounting for direct product costs (Ailawadi and Harlam 2002). As for the latter, the retailer may introduce a store brand to exploit untapped segments or steal value-conscious consumers away from the national brands (Connor and Peterson 1992).

Finally, potential retailer-demand benefits at the store level include increased store traffic and store revenues. Recent research suggests that store brands make shopping easier for consumers, and that they increase store image and store loyalty by improving store differentiation vis-à-vis other retailers (Hoch and Lodish 2003). Recent empirical findings indeed connect store brand use and store loyalty (Ailawadi et al. 2001, Corstjens and Lal 2000). However, it appears unlikely that store brand entry in any one category would significantly increase store traffic, given at best modest store-switching effects reported in previous literature (Walters and McKenzie 1988). Therefore, we do not expect the introduction of a store brand in a single category to influence store performance.

In summary, we expect the retailer to benefit from store brand entry through (1) higher unit margins on the national brands, (2) category expansion from the store brand itself and/or from higher volumes on the national brands, and (3) higher gross category margin, as a result of (1), (2), and retailer margin on the store brand itself.

2.2. Impact of Store Brand Entry for Manufacturers

When the retailer enters a category with a store brand, the retailer changes from being a customer to being a competitor for the national brand manufacturers. Consequently, it is important for national brand manufacturers to understand how store brand entry affects their own performance and how they should react to this event. Previous literature suggests that the relative *positioning* of the incumbent brands vis-à-vis the new entrant affects both the incumbent's *performance impact* and the incumbent's optimal *defensive reaction*. We discuss these topics in turn.

Table 1 Summary of Hypotheses and Empirical Results

Hypothesis: Store brand entry results in:		Hot breakfast cereal	Toothbrush	Paper towel	Soap
H1	Higher unit margins for the retailer	Yes	Yes	Yes	Some
H2	Category expansion for the retailer	Yes	No	No	No
H3	Higher category margin for the retailer	Yes	No	No	No
H4	a) Premium brands maintain/increase share	Yes	Yes	Yes	Yes
	b) Second-tier brands lose share	Yes	Some	Yes	Some
H5	a) Premium brands maintain/raise wholesale price	Yes	Yes	Yes	Yes
	b) Second-tier brands cut wholesale price	Yes	No	Yes	No
H6	a) Premium brands maintain/increase revenue	Yes	Yes	Yes	Yes
	b) Second-tier brands lose revenue	Yes	Some	Yes	Some
H7	a) Premium brands maintain/lower price sensitivity	Yes	Yes	Yes	Yes
	b) Second-tier brands increase price sensitivity	Yes	Some	Yes	Some
H8	a) Higher retail prices for premium brands	Yes	Yes	Yes	Yes
	b) Lower retail prices for second-tier brands	Yes	No	Yes	Some
H9	Lower average price paid in category	Yes	Yes	No	No
H10	Higher product variety in product category	Yes	Yes	Yes	Yes

In the broader context of defensive strategies, Hauser and Shugan (1983) proposed the Defender modeling framework to understand how a brand ought to respond to competitive entry. Later expansions (e.g., Gruca et al. 2001) agree that the first consideration is the extent to which the entrant is competitive with the incumbent brand and thus will affect the incumbent's performance. This degree of competition depends on the relative positioning of the brands, with price and perceived quality as key dimensions (Blattberg and Wisniewski 1989). In the case of store brand entry, consumers are typically willing to pay more for national brands versus store brands based on perceived quality differences (Mills 1995, Narasimhan and Wilcox 1998, Raju et al. 1995). The literature on asymmetric and neighborhood price effects indeed confirms that while premium-tier national brands are relatively insulated from store brands, consumers of lower-priced national brands are more likely to switch to store brands (Blattberg and Wisniewski 1989, Sethuraman et al. 1999). Therefore, the store brand is more likely to compete with second-tier brands than with premium-tier national brands (Dhar and Hoch 1997, Hoch and Lodish 2003).

Besides the performance impact, the incumbent's positioning also affects their optimal defensive reaction. In their expanded framework of discrete market segments, Gruca et al. (2001) find that the direction of optimal price changes depends on the degree of overlap among the segment's choice sets. If the entrant brand does not fully compete in all consumer segments, the optimal incumbent brand's reaction depends on its closeness to the entrant's position.

On the one hand, incumbents closest to the entrant should reduce prices. Indeed, incumbents often intensify price competition by offering temporary price promotions (Lal 1990) or by introducing lower-priced varieties (Hoch 1996, Quelch and Harding 1996). On the other hand, incumbents furthest away from the entrant should raise prices. Intuitively, this price increase is optimal because the entrant drives the incumbent out of price-sensitive segments, but leaves the incumbent's core segments untouched (Hauser and Shugan 1983). Store brand entry and the prospect of a resulting price war at the lower end of the market may indeed lead premium national brands to abandon (occasional) attempts to attract price-conscious consumers and to focus exclusively on their core quality-conscious consumers. This renewed focus allows a price increase, especially when combined with quality improvements. Indeed, Hauser and Shugan (1983) recommend product improvement and repositioning away from the entrant's strength. Because store brands usually compete on price, premium-tier national brands could build on their strength by introducing high-end product varieties, which increases average brand price. As these potentially different incumbent reactions play out, entry of a store brand may redefine competitors in the market, with price competition intensifying between some brands but not between others (Gruca et al. 2001).

In summary, we expect the relative positioning of the incumbent national brands to affect both the impact of store brand entry on performance and the defensive strategy followed by these incumbent brands. *First, store brands are more likely to compete with, and hence hurt, the performance of second price-tier national brands rather than first price-tier (premium) national brands*. As a result, second-tier brands will adopt a more retaliatory defensive strategy (such as *decreasing* the average brand price) than other national brands. In fact, premium national brands may well accommodate the store brand entry by *maintaining or even increasing average brand price*. Evidently, the key to defensive action is knowledge about how consumers react to store brand entry, the issue to which we turn next.

2.3. Impact of Store Brand Entry on Consumers

The responses of the consumers to store brand entry and the resulting category environment are of crucial importance for both the retailer and the manufacturers. First, the new store brand may create additional demand for the product or share the existing market by drawing buyers from existing brands (Dekimpe et al. 1997). Second, store brand entry may change consumer price sensitivity in the category. In assessing the impact of entry on incumbent price sensitivity, Huber et al. (1986) categorize brands as "bracketed" (in the middle of the price-quality continuum) versus "boundary" (at the high or low end of the continuum). Brands that switch from a boundary to a bracketed condition should experience increased price sensitivity (as supported in simulations by Gruca et al. 2001). In our case of store brand entry, incumbents with relatively low price points may change from a boundary to a bracketed brand and thus experience increased price elasticity. As higher price sensitivity implies a lower optimal price, these incumbents are likely to increase discounting. In contrast, high-end incumbents will not switch from boundary to bracketed and may even experience reduced price sensitivity as they focus on their core quality-conscious consumers. Therefore, their optimal price does not decrease and may even increase. These predictions have yet to be empirically confirmed.

Store brand entry may benefit consumers in several ways. First, the presence of a new brand increases consumer choice in the category and thus may improve category attractiveness (Mason 1990). Second, the typical low price and reasonable quality of a

store brand compared to the existing national brands (Hoch and Banerji 1993) may convert some price-conscious shoppers who normally do not buy in the category into regular category consumers. Third, the competitive reactions of national brands may include product improvements and price reductions, both of which in turn increase category value. However, several theoretical frameworks shed doubt on a category-wide decrease in retail prices. In Mills' (1995) model, wholesale prices fall more than retail prices do, as store brand share increases. Lee and Staelin (2000) argue that store brand entry does not lead to lower retail prices, but does reduce wholesale prices, especially when the national brands are undifferentiated. Therefore, it remains an empirical question whether store brand entry actually benefits consumers through lower retail prices on national brands and lower average price paid in the category.

In sum, the impact of store brand entry for the retailer, the national brand manufacturers, and consumers remains an empirical puzzle in existing marketing literature. We seek to fill this void by assessing the transitory versus permanent financial impact of store brand entry on manufacturers, retailers, and consumers by using data for seven years from four categories and examining the impact of store brand entry on long-term price sensitivity. In the next section, we introduce time-series techniques to address these questions.

3. Methodology

In recent years, time-series methods such as unit-root tests and cointegration tests, vector autoregressive models (VARX) and vector error-correction models (VECM), have emerged to quantify the long-run impact of marketing activity (Dekimpe and Hanssens 1999, Bronnenberg et al. 2000). However, these studies examine the performance implications of temporary price promotions or gradual increases in distribution rather than the structural changes that occur as a result of store brand entry. An event such as store brand may result in a market shake-up, changing the underlying data-generating process (Pesaran and Samiei 1992). Therefore, we use structural break analyses in conjunction with VARX models to assess (1) to what extent store brand entry created a permanent (structural) change to the level, trend slope, and variance of each variable; (2) whether interactions among performance and marketing variables differ before versus after store brand entry; and (3) how long-term price response differs in the new competitive environment.

Our methodological approach consists of three steps. First, we introduce structural break unit-root tests to investigate whether store brand entry created structural change to each variable (univariate). Next, we analyze how performance and marketing variables interact in a vector autoregressive model with exogenous variables (VARX) and how these interactions changed with store brand entry (multivariate). Finally, we contrast long-term price sensitivity in the pre- and postentry periods by estimating and comparing price impulse response functions. Table 2 summarizes and integrates these methodological building blocks.

3.1. Permanent vs. Transitory Impact of Store Brand Entry: Structural Break Unit-Root Tests

Our analysis proceeds sequentially. First, we test for evolution versus stationarity of all performance and price series by applying the Augmented Dickey-Fuller (ADF) procedure (Enders 1995, p. 257) to check for the presence or absence of unit roots. While the ADF test is the most widely used unit-root test in marketing, several factors may bias its results (Maddala and Kim 1998). Specifically in our context, store brand entry may induce changes in the level, trend slope, and the error term of Equation (1).[1] As for the latter, we perform Brown-Forsythe (modified Levene) tests for a significant difference in the variance of each series in the pre- versus postentry period. When there is heteroskedasticity in the error term, the appropriate unit-root test to use is the Phillips-Perron (PP) test (1988). Moreover, because both ADF and PP unit-root tests are known to be biased towards finding evolution when there is a structural break to the level and/or trend slope of the studied variable, we subject all the series to the innovational-outlier (IO) test of Perron (1990). Finally, we acknowledge that the exact date of store brand entry is only one candidate for a structural break in the performance variables, as manufacturers and consumers may react with lead/lags to store brand entry. Therefore, we perform the endogenous break test (Zivot and Andrews 1992), which endogenously determines breakpoints over the data period.

In case more than one variable is found to have a unit root, we test for a long-run equilibrium, known as cointegration, among those variables (Maddala and Kim 1998). Consistent with our research focus, we apply the recent extension to the Johansen cointegration test (Johansen et al. 2000) that accounts for structural breaks. Finally, we test for the possibility that store brand entry affects the long-run relationship between variables by performing the test in Gregory and Hansen (1996a, b), allowing structural change in the cointegrating relationship.

[1] We found no evidence of changes in the holiday and seasonal parameters, which in principle might also be affected.

Table 2 Overview of Time-Series Techniques to Assess the Impact of Store Brand Entry

Methodological approach	Relevant literature	Research questions
1. Unit-root, structural change, and cointegration tests		*What is the structural change to each performance and price variable, due to store brand entry?*
Augmented Dickey-Fuller	Dickey and Fuller (1979)	Are performance and marketing variables stationary (mean-reverting) or evolving (unit root)?
Variance change F test	Brown and Forsythe (1974)	Does the variance of the performance and marketing variables change (heteroscedasticity)?
Phillips-Perron unit-root test	Phillips and Perron (1988)	Are the unit-root test results robust to heteroscedasticity?
Structural break unit-root test	Perron (1989) Perron (1990)	Is there a permanent (structural) impact of store brand entry on the level or trend slope?
Endogenous break test	Zivot and Andrews (1992) Kornelis et al. (2001)	Is there a structural break over the whole time-series of the performance and price variables?
Cointegration test	Johansen and Juselius (1990)	Do evolving variables move together?
Cointegration test with structural breaks	Gregory and Hansen (1996a, b) Johansen et al. (2000)	Do evolving variables move together after allowing for structural breaks?
2. VARX model		*Do interactions among performance and price variables differ before versus after store brand entry?*
Vector autoregressive model with exogenous variables (VARX)	Enders (1995) Dekimpe and Hanssens (1995) Bronnenberg et al. (2000)	How do performance and price variables interact, accounting for exogenous factors?
Parameter stability tests	Andrews (1993) Charemza and Deadman (1997) Wolters et al. (1998)	Does store brand entry change the parameters of the VAR model?
VAR static pre- and postequilibrium levels	Srinivasan et al. (2000)	Who benefits from store brand entry—the retailer, the manufacturers, or the consumers?
3. Impulse-response analysis		*How does long-term price response differ before versus after store brand entry?*
Sales response to a unit price shock (price promotion)	Hamilton (1994) Pauwels et al. (2002)	How does long-term price elasticity differ before versus after store brand entry?
Performance response to a unit price shock (price promotion)	Srinivasan et al. (2001)	How is long-term performance response different before versus after store brand entry?

3.2. Vector Autoregressive Model with Exogenous Variables (VARX)

We extend the vector autoregressive modeling approach to capture (i) the long-run impact of store brand entry into the market and (ii) the dynamic interactions between performance series and marketing variables before and after store brand entry. Previously, VARX models have been used to assess the long-run effects of marketing activity such as advertising, distribution, and price promotions (Dekimpe and Hanssens 1999, Srinivasan et al. 2001, Pauwels et al. 2002). Such models are especially well suited to measure dynamic interactions between performance and marketing variables and to estimate dynamic market response (Dekimpe and Hanssens 1995). Tractability and reliable estimation of this highly flexible model requires selectivity in the number of variables to include in one VARX model, and whether to treat them as endogenous or exogenous (Pesaran and Smith 1998). For each category, we simultaneously model brand volume sales, $VOL_{i,t}$, together with the retail prices ($P_{i,t}$), the wholesale prices ($WP_{i,t}$) for all major brands and an "other brands" composite. From these variables, we can reconstruct our performance measures detailed in §4: sales and manufacturer revenues at the brand level; and sales, retailer revenues, and retailer margin at the category level. To investigate store-level effects, we replace the brand volume series with store traffic and average shopper spending.

The treatment of prices as endogenous implies that they too are explained by their own past and the past of the performance variables. Specifically, the VARX model accounts for dynamic performance response to marketing, for lagged effects of performance on own prices (performance feedback), and for dynamic interactions with competitive prices. The contemporaneous effects among the endogenous variables are modeled through the residual covariance matrix (Lütkepohl 1993). The first set of exogenous variables includes (i) the intercept, (ii) four weekly seasonal dummy variables (SD_{st}), (iii) ten holiday dummy variables that equal one in the shopping periods around each major holiday[2] (HD_{ht}), and (iv) a

[2] Major holidays are Lent, Easter, Memorial Day, July 4th, Labor Day, Halloween, Thanksgiving, the week following Thanksgiving, Christmas, and Superbowl (Chevalier et al. 2003). The database contains weekly data in which the weeks start on Thursday and end on Wednesday. We generate a set of dummy variables, one for

deterministic-trend variable (t) to capture the impact of omitted, gradually changing variables. The second set of exogenous variables includes (i) feature (FT) activity, (ii) display (DP) activity, and (iii) product variety (PV) for each brand. We choose to include these marketing actions as exogenous variables because (1) we want to avoid overparametrization bias to affect our estimates of the price coefficients, the focus of our study (Pesaran and Smith 1998), (2) recent research has shown little is gained by allowing for more intricate feature and display dynamics (Nijs et al. 2001, Srinivasan et al. 2001, Van Heerde et al. 2000), and (3) the measurement, and hence the time series, of these variables typically differs substantively from those of prices. In particular, feature, display, and product activity are often recorded as dummy variables, and product assortments logically change much more slowly than prices do.

VARX models are specified in levels, differences, or error-correction format, depending on the results of the unit-root and cointegration tests (Powers et al. 1991). If all series are level or trend stationary, we formulate the following model in a category with three brands:

$$
\begin{bmatrix} VOL_{1t} \\ VOL_{2t} \\ VOL_{3t} \\ P_{1t} \\ P_{2t} \\ P_{3t} \\ WP_{1t} \\ WP_{2t} \\ WP_{3t} \end{bmatrix}
= \begin{bmatrix}
a_{0,\,VOL1} + \sum_{s=2}^{13} a_{s,\,VOL1}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,VOL1}\, HD_{h,\,t} + \partial_{VOL1} t \\
a_{0,\,VOL2} + \sum_{s=2}^{13} a_{s,\,VOL2}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,VOL2}\, HD_{h,\,t} + \partial_{VOL2} t \\
a_{0,\,VOL3} + \sum_{s=2}^{13} a_{s,\,VOL3}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,VOL3}\, HD_{h,\,t} + \partial_{VOL3} t \\
a_{0,\,P1} + \sum_{s=2}^{13} a_{s,\,P1}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,P1}\, HD_{h,\,t} + \partial_{P1} t \\
a_{0,\,P2} + \sum_{s=2}^{13} a_{s,\,P2}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,P2}\, HD_{h,\,t} + \partial_{P2} t \\
a_{0,\,P3} + \sum_{s=2}^{13} a_{s,\,P3}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,P3}\, HD_{h,\,t} + \partial_{P3} t \\
a_{0,\,WP1} + \sum_{s=2}^{13} a_{s,\,WP1}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,WP1}\, HD_{h,\,t} + \partial_{WP1} t \\
a_{0,\,WP2} + \sum_{s=2}^{13} a_{s,\,WP2}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,WP2}\, HD_{h,\,t} + \partial_{WP2} t \\
a_{0,\,WP3} + \sum_{s=2}^{13} a_{s,\,WP3}\, SD_{s,\,t} + \sum_{h=1}^{10} a_{h,\,WP3}\, HD_{h,\,t} + \partial_{WP3} t
\end{bmatrix}
$$

$$
+ \sum_{i=1}^{K} \begin{bmatrix}
\beta_{11}^i & \beta_{12}^i & \beta_{13}^i & \beta_{14}^i & \beta_{15}^i & \beta_{16}^i & \beta_{17}^i & \beta_{18}^i & \beta_{19}^i \\
\beta_{21}^i & \beta_{22}^i & \beta_{23}^i & \beta_{24}^i & \beta_{25}^i & \beta_{26}^i & \beta_{27}^i & \beta_{28}^i & \beta_{29}^i \\
\beta_{31}^i & \beta_{32}^i & \beta_{33}^i & \beta_{34}^i & \beta_{35}^i & \beta_{36}^i & \beta_{37}^i & \beta_{38}^i & \beta_{39}^i \\
\beta_{41}^i & \beta_{42}^i & \beta_{43}^i & \beta_{44}^i & \beta_{45}^i & \beta_{46}^i & \beta_{47}^i & \beta_{48}^i & \beta_{49}^i \\
\beta_{51}^i & \beta_{52}^i & \beta_{53}^i & \beta_{54}^i & \beta_{55}^i & \beta_{56}^i & \beta_{57}^i & \beta_{58}^i & \beta_{59}^i \\
\beta_{61}^i & \beta_{62}^i & \beta_{63}^i & \beta_{64}^i & \beta_{65}^i & \beta_{66}^i & \beta_{67}^i & \beta_{68}^i & \beta_{69}^i \\
\beta_{71}^i & \beta_{72}^i & \beta_{73}^i & \beta_{74}^i & \beta_{75}^i & \beta_{76}^i & \beta_{77}^i & \beta_{78}^i & \beta_{79}^i \\
\beta_{81}^i & \beta_{82}^i & \beta_{83}^i & \beta_{84}^i & \beta_{85}^i & \beta_{86}^i & \beta_{87}^i & \beta_{88}^i & \beta_{89}^i \\
\beta_{91}^i & \beta_{92}^i & \beta_{93}^i & \beta_{94}^i & \beta_{95}^i & \beta_{96}^i & \beta_{97}^i & \beta_{98}^i & \beta_{99}^i
\end{bmatrix}
$$

$$
* \begin{bmatrix} VOL_{1t-i} \\ VOL_{2t-i} \\ VOL_{3t-i} \\ P_{1t-i} \\ P_{2t-i} \\ P_{3t-i} \\ WP_{1t-i} \\ WP_{2t-i} \\ WP_{3t-i} \end{bmatrix}
+ \begin{bmatrix}
\gamma_{11} & \gamma_{12} & \gamma_{13} \\
\gamma_{21} & \gamma_{22} & \gamma_{23} \\
\gamma_{31} & \gamma_{32} & \gamma_{33} \\
\gamma_{41} & \gamma_{42} & \gamma_{43} \\
\gamma_{51} & \gamma_{52} & \gamma_{53} \\
\gamma_{61} & \gamma_{62} & \gamma_{63} \\
\gamma_{71} & \gamma_{72} & \gamma_{73} \\
\gamma_{81} & \gamma_{82} & \gamma_{83} \\
\gamma_{91} & \gamma_{92} & \gamma_{93}
\end{bmatrix}
* \begin{bmatrix} FT_1 \\ FT_2 \\ FT_3 \end{bmatrix}
+ \begin{bmatrix}
\delta_{11} & \delta_{12} & \delta_{13} \\
\delta_{21} & \delta_{22} & \delta_{23} \\
\delta_{31} & \delta_{32} & \delta_{33} \\
\delta_{41} & \delta_{42} & \delta_{43} \\
\delta_{51} & \delta_{52} & \delta_{53} \\
\delta_{61} & \delta_{62} & \delta_{63} \\
\delta_{71} & \delta_{72} & \delta_{73} \\
\delta_{81} & \delta_{82} & \delta_{83} \\
\delta_{91} & \delta_{92} & \delta_{93}
\end{bmatrix}
$$

$$
* \begin{bmatrix} DP_1 \\ DP_2 \\ DP_3 \end{bmatrix}
+ \begin{bmatrix}
\rho_{11} & \rho_{12} & \rho_{13} \\
\rho_{21} & \rho_{22} & \rho_{23} \\
\rho_{31} & \rho_{32} & \rho_{33} \\
\rho_{41} & \rho_{42} & \rho_{43} \\
\rho_{51} & \rho_{52} & \rho_{53} \\
\rho_{61} & \rho_{62} & \rho_{63} \\
\rho_{71} & \rho_{72} & \rho_{73} \\
\rho_{81} & \rho_{82} & \rho_{83} \\
\rho_{91} & \rho_{92} & \rho_{93}
\end{bmatrix}
* \begin{bmatrix} PV_1 \\ PV_2 \\ PV_3 \end{bmatrix}
+ \begin{bmatrix}
\varepsilon_{VOL1,\,t} \\ \varepsilon_{VOL2,\,t} \\ \varepsilon_{VOL3,\,t} \\ \varepsilon_{P1,\,t} \\ \varepsilon_{P2,\,t} \\ \varepsilon_{P3,\,t} \\ \varepsilon_{WP1,\,t} \\ \varepsilon_{WP2,\,t} \\ \varepsilon_{WP3,\,t}
\end{bmatrix} \tag{1}
$$

with $[\varepsilon_{VOL1,\,t}, \varepsilon_{VOL2,\,t}, \varepsilon_{VOL3,\,t}, \varepsilon_{P1,\,t}, \varepsilon_{P2,\,t}, \varepsilon_{P3,\,t}, \varepsilon_{WP1,\,t}, \varepsilon_{WP2,\,t}, \varepsilon_{WP3,\,t}]' \sim N(0, \Sigma)$ and k refers to the order of the VARX model, which is determined by the Schwarz Bayesian Criterion (SBC). The SBC is a consistent estimator of the lag order and also yields better forecasts than alternative criteria in finite samples (Lütkepohl 1993). Depending on the outcome of the unit-root and cointegration tests, the model in Equation (1) is adjusted as follows: (1) for level-stationary series, the parameter ∂ is set to zero; (2) for evolving series, the first difference of the series is included in the model; (3) for cointegrating series, we estimate a Vector Error-Correction Model (VECM) with an error term that captures adjustment towards long-run equilibrium (Dekimpe and Hanssens 1999).

3.3. Parameter Stability and Structural Change in the Multivariate Equilibrium

Given the specified VARX model, we are now able to assess whether store brand entry changed the dynamic interactions in this multivariate system.

each holiday. For Thursday holidays, the corresponding dummy variable is set to 1 for the two weeks prior to the holiday, but zero for the week including the holiday. For holidays taking place on all other days, the dummy variable is set to 1 for the week before the holiday and the week including the holiday.

First, we assess whether store brand entry affected the stability of the model's parameters. Because this change date is known, we use the Wald test of structural change (Kornelis et al. 2001).[3] Next, if the parameter stability tests show structural shifts in the data-generating process of the key variables, we assess the sign, size, and significance of the structural change. A first option is to include interaction terms of the store brand entry dummy with each of the model components, which is appropriate in the absence of a strong hypothesis that only some model components change (Kornelis et al. 2001). Such a procedure would drastically reduce the degrees of freedom in the VARX model, especially when one also needs to account for variance changes in the endogenous variables (as revealed by the Brown-Forsythe tests of our first methodological step). An equivalent and efficient way of capturing these phenomena is to *estimate pre- and postentry VARX models* separately and to compare the multivariate equilibrium levels and the long-term price response of the performance variables. Note that "equilibrium" is defined in a statistical sense as the matrix of stable means to which the variables revert after being shocked. This multivariate equilibrium is calculated from the data and does not have a theoretical economic interpretation (Hamilton 1994, Srinivasan et al. 2000). Specifically, we calculate the multivariate equilibrium levels—based on the VARX model—for the pre- and postentry periods. In addition to the preentry variables, the postentry VARX model includes the store brand's volume, retail price, and wholesale price as endogenous variables and its display, feature, and product activity as exogenous variables.

To formally compare the pre- and postentry equilibrium, we obtain standard errors by the Monte Carlo simulation approach. Specifically, we sample 250 draws of the estimated VAR parameters using the means and covariances, and then calculate the equilibrium levels associated with each set of draws. We then use these 250 draws to compute the empirical means and standard errors for the equilibrium values for all endogenous variables and hence conduct stringent tests of differences in the pre- and postintroduction periods.

3.4. Impulse Response Analysis of the Over-Time Impact of a Price Shock on Performance

The estimated VARX models allow us to simulate the over-time effects of a marketing action on each performance variable (Dekimpe and Hanssens 1999). Note from Equation (1) that VARX models capture immediate as well as lagged, direct as well as indirect, interactions among the endogenous variables (Srinivasan et al. 2001). Our main interest lies in the net result of all these actions and reactions over time, which can be derived from a VARX model through its associated impulse-response functions. These impulse-response functions estimate the incremental effect of a "shock" to a marketing variable on the performance variables relative to their baselines (their expected values in the absence of the marketing shock). Specifically, we measure the long-term performance response to a one-unit price shock (Dekimpe et al. 1999, Pauwels et al. 2002). Because we did not have prior information on leaders versus followers in promotional decisions, we adopted the simultaneous-shocking approach (Evans and Wells 1983, Dekimpe and Hanssens 1999), in which the information in the residual variance-covariance matrix of Equation (1) is used to derive a vector of *expected* instantaneous shock values. Standard errors are subsequently derived using the Monte Carlo simulation approach with 250 runs in each case (Dekimpe and Hanssens 1999). We estimate impulse response functions on the pre- and postentry VARX models. Next, we accumulate all significant impulse response coefficients to compute the long-run (cumulative) impact of a price shock (Pauwels et al. 2002). The difference between the performance impact before versus after store brand entry represents the change in long-run price sensitivity in the new multivariate equilibrium.

3.5. Level of Analysis

Because the retailer's costly decision to introduce a store brand is typically a chainwide initiative, we want to assess the economic consequences for all parties at the chain, instead of at the store, level. We guard against aggregation bias (e.g., Allenby and Rossi 1991, Pesaran and Smith 1998) by performing a pooling test and by estimating a pooled fixed-effect model that accommodates heterogeneity among stores (e.g., Horváth and Wierenga 2002) to validate our chain-level findings. Potential loss of efficiency is limited because of the large number of time-series observations in our dataset.[4]

4. Data Description

The time series we use are based on scanner data from a large Midwestern supermarket chain, Dominick's Finer Foods. With 96 stores in and around Chicago, this is one of the two largest chains in the area. The relevant variables include unit sales at the SKU level, retail (consumer) prices, feature and display activity,[5] store traffic, and store revenue. Additionally, retail

[3] The appropriate test when the change date is unknown is the sup-Wald test (Andrews 1993).

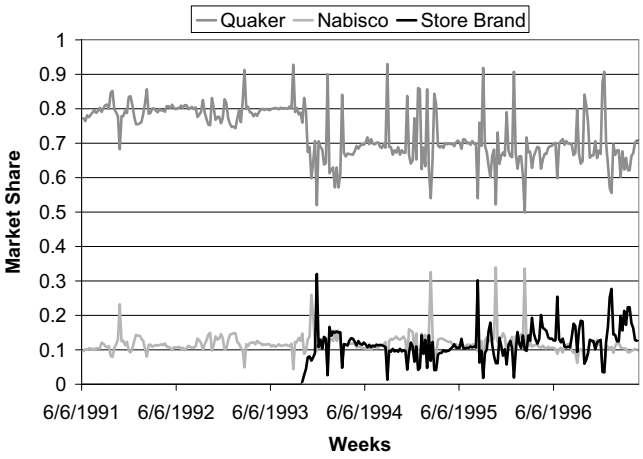
[4] We thank an anonymous reviewer and the associate editor for these observations.

[5] Feature and display indicators are called price specials and bonus buys in the Dominick's data description (http://gsbwww.

margin data allow us to calculate the average acquisition cost of each SKU to the retailer. Because the retailer herself uses this data to judge profitability, the average acquisition cost is a useful, though imperfect,[6] measure of the wholesale price of the manufacturer to the retailer, given the purpose of our paper (see Chevalier et al. 2003 and Chintagunta 2002 for a detailed discussion). All price data are appropriately deflated using the Consumer Price Index; the base (= 100) is week 1 of our observation series, beginning in September 1989. A total of 399 weeks of data are available for the time period from September 1989 to May 1997. As we are studying the chainwide impact of store brand entry, we aggregate sales volume data across stores and the SKU data to the brand level using constant weights (average share across the full sample period; see Pauwels et al. 2002, Footnote 2). Potential store aggregation bias is limited because Dominick's adopts a uniform product strategy and conducts a chainwide promotional strategy in which prices are lowered by a uniform percentage across all stores in the chain (Hoch et al. 1995, pp. 27–28).

Out of a total of 25 product categories, five feature store brand entry within the available data period: hot breakfast cereal, toothbrushes, paper towels, bath (bar) soap, and frozen pasta.[7] The latter category is shaken up by two highly successful national brand entries right before store brand entry, with an explosion in category volume as a result. Moreover, we have only 36 weeks of clean data in the postentry period, resulting in insufficient observations to estimate the VARX models. For these reasons we do not study the frozen pasta category. Within the four remaining categories, we focus on the major national brands and the store brand. For hot breakfast cereal, we consider premium brand Nabisco,[8] with average preentry retail price of \$1.28, and second-tier brand Quaker, with average retail price of \$1.09. The store brand is introduced in October 1993 and has an average retail price of \$0.80. Figures 1–3 show, respectively, market share, retail prices, and wholesale prices for Quaker, Nabisco, and the store brand. For toothbrushes, we focus on the three main national brands: premium brand Oral-B and second-tier brands Reach and Colgate, with preentry average retail prices of, respectively, \$2.14, \$1.69, and \$1.67. The store brand is introduced in October 1990[9] for an average retail price of \$1.15. In the paper towels category, brands Bounty, Viva, and Scott have average retail prices of \$0.94, \$0.91, and \$0.85. Dominick's introduces a similar-size store brand in July 1992 for an average retail price of \$0.50. Finally, in the soap category, brands Dove, Lever 2000, Dial, and Ivory have preentry average retail prices of \$2.17, \$1.45, \$1.34, and \$1.11, respectively, and Dominick's introduces a store brand in June 1995 for an average retail price of \$1.03.

Figure 1 **Market Shares for the Hot Breakfast Cereal Brands Quaker, Nabisco, and the Store Brand**



Note that, as expected, the store brand enters as the lowest-priced brand in each category. Moreover, each category includes premium-priced brands (Nabisco, Oral-B, Bounty, Viva, Dove, Lever 2000) and second-tier-priced brands (Quaker, Reach, Colgate, Scott, Dial, Ivory). In the remainder of this paper, we therefore refer to the former as "premium national brands" and to the latter as "second-tier national brands."

uchicago.edu/research/mkt/Databases/DFF/W.html). Following Chintagunta et al. (2001), we refer to these marketing activities through the more common labels of "feature" and "display."

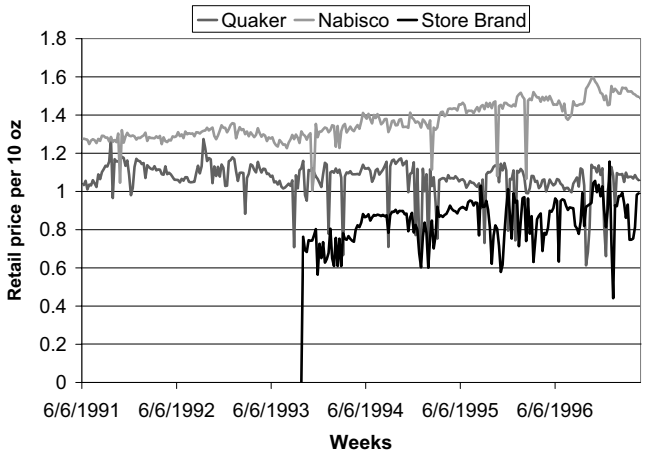
[6] The acquisition cost averages wholesale prices over time, which induces additional autocorrelation as the measure only slowly adjusts to manufacturer deals. By the same token, however, the acquisition cost incorporates forward buying, which makes it an attractive measure to compare retailer margins before and after store brand entry. Finally, the average acquisition cost does not include manufacturer allowances or other side payments to the retailer.

[7] Store brand entry is simply defined as the fact that the retailer starts offering at least 1 SKU of the store brand during the data period, irrespective of whether the store brand was still offered at the end of the data period or of its achieved market share. Therefore, the results do not appear to be subject to survivor bias as were, for example, early studies on first-mover advantage (Lieberman and Montgomery 1988).

[8] We thank an anonymous reviewer for pointing out that Nabisco's product form is wheat, while Quaker's and the store brand's is oat. Our reasons for including Nabisco are twofold: (1) The retailer includes this brand in the hot breakfast cereal category, both physically (shelf placement) and conceptually (in the dataset); and (2) our analysis shows that Nabisco has significant cross-price elasticities with both Quaker and the store brand.

[9] As noted by an anonymous reviewer, Dominick's also introduces a Gem subbrand, which is priced considerably higher than the national brands at about \$2.00. We do not include this brand as it is introduced much later (November 1993) and is not representative for the typical store brand studied in this paper. However, the analysis of high price-tier store brands remains an interesting area for future research.

Figure 2 **Retail Prices (per 10 oz) for the Hot Breakfast Cereal Brands Quaker, Nabisco, and the Store Brand**



Performance Measures. For the *manufacturer*, we consider brand sales as well as manufacturer revenues, defined as:

$$MR_{i,t} = VOL_{i,t} \times WP_{i,t},$$

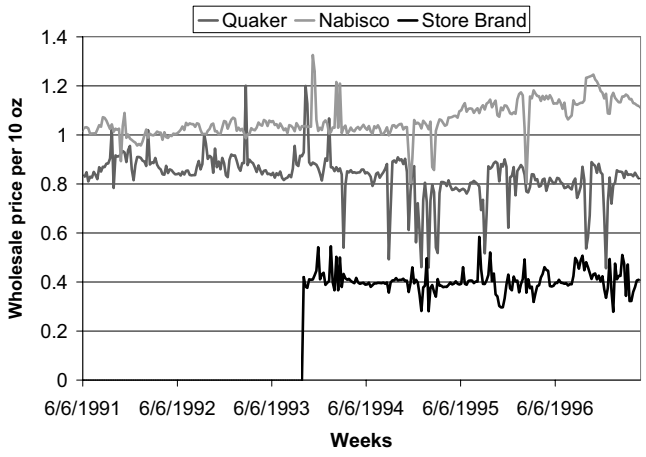
where $VOL_{i,t}$ refers to sales volume of brand i at time t, and $WP_{i,t}$ is the wholesale price of brand i at time t (Srinivasan et al. 2001). For the retailer, a more extensive set of performance measures is considered. In addition to category sales, we also derive the total category revenue:

$$RR_t = \sum_{i=1}^{n} VOL_{i,t} \times P_{i,t},$$

where $P_{i,t}$ refers to the price of brand i at time t and n is the total number of brands in a category. Additionally, we compute retailer total category margins (defined in dollars) as:

$$RM_t = \sum_{i=1}^{n} VOL_{i,t} \times (P_{i,t} - WP_{i,t}).$$

Figure 3 **Wholesale Prices (10 oz) for the Hot Breakfast Cereal Brands Quaker, Nabisco, and the Store Brand**



For a similar operationalization of retailer performance measures, see Srinivasan et al. (2001). We also analyze two store-level performance variables—store revenue and store traffic. The feature and display promotional variables for each brand are operationalized as the percentage of SKUs that are promoted in a given week. Product variety is operationalized as the number of SKUs for each brand in a given week. Finally, promotional frequency and depth (Jedidi et al. 1999) are defined consistently with the impulse-response functions that estimate the incremental effect of a "shock" to price: A promotion week is defined as a week in which the price shock is at least two standard deviations below the mean shock. We define the brand's price-promotion frequency as the proportion of promotion weeks (as defined above) for the brand and the brand's price-promotion depth as the (percentage) difference between a brand's promotional price shock (in a promotion week) and the brand's average price averaged across all nonpromotion weeks.

It is important to note that our data cannot yield an exhaustive account of all effects of, and reactions to, store brand entry. Specifically, we do not observe trade deal activity, advertising, and interretail competition. Moreover, we do not have a direct measure of quality and quality changes.[10] Still, we feel that the length and breadth of the available time series, together with the distinction between wholesale and retail prices, allow us to answer important questions on the long-run impact of store brand entry for the retailer, the manufacturers, and the consumers.

5. Results

In correspondence with our methodology discussion, we first examine whether store brand entry structurally changes each of the manufacturer and retailer performance and marketing variables (Univariate Result Tables 3–6). We then discuss who benefits from store brand entry, based on the VARX multivariate equilibrium levels of these variables (Tables 7–10). Finally, we contrast long-term price sensitivity in the pre- and postentry periods (Table 11).

5.1. Unit-Root and Structural Change Test Results

For each manufacturer and retailer performance and marketing series, we discuss (1) whether a structural change occurred to the level or trend slope (evidenced by evolution results for the ADF and PP unit-root tests, but stationarity results for the Perron or Zivot-Andrews tests that allow for a structural break)

[10] Our indirect measure of perceived quality change is based on the following reasoning: If a brand increases real prices without incurring a volume loss, consumers perceive its quality to be improved.

Table 3 Results of the Unit-Root and Structural Change Tests for the Hot Breakfast Cereal Category[1]

Performance measure marketing variable	ADF unit-root test	Brown-Forsythe variance test	Phillips-Perron unit-root test	Perron structural break test	Zivot and Andrews test
Manufacturer NABISCO					
Brand sales (ounces)	Stationary	Increase	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	Increase	Stationary	Stationary	Stationary
Brand shares (%)	Stationary	Increase	Stationary	Stationary	Stationary
Product variety	Stationary	No change	Stationary	Stationary	Stationary
Wholesale price ($)	Trend stationary	No change	Trend stationary	Trend stationary	Trend stationary
Manufacturer QUAKER					
Brand sales (ounces)	Stationary	Increase	Stationary	Stationary	Stationary
Brand revenue ($)	Evolving	Increase	Evolving	Stationary	Stationary
Brand shares (%)	Evolving	Increase	Evolving	Stationary	Stationary
Product variety	Stationary	No change	Stationary	Stationary	Stationary
Wholesale price ($)	Stationary	Increase	Stationary	Stationary	Stationary
RETAILER					
Category sales (ounces)	Evolving	Increase	Evolving	Evolving	Stationary
Category revenue ($)	Stationary	Increase	Stationary	Stationary	Stationary
Category margin ($)	Evolving	Increase	Evolving	Stationary	Stationary
Store traffic	Stationary	Increase	Stationary	Stationary	Stationary
Store revenue ($)	Stationary	Increase	Stationary	Stationary	Stationary
Retail price Nabisco ($)	Trend stationary	Increase	Trend stationary	Trend stationary	Trend stationary
Retail price Quaker ($)	Stationary	Increase	Stationary	Stationary	Stationary
Average price paid ($)	Evolving	Increase	Evolving	Stationary	Stationary
Feature Nabisco (%)	Stationary	No change	Stationary	Stationary	Stationary
Feature Quaker (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Nabisco (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Quaker (%)	Stationary	No change	Stationary	Stationary	Stationary
Category product variety	Evolving	Increase	Evolving	Stationary	Stationary

[1]All unit-root and structural change tests are reported at the 5% significance level.

and (2) whether a structural change occurred to the variance.

Hot Breakfast Cereal Category. Table 3 reports the test results for the hot breakfast cereal category.[11]

For *second-tier brand Quaker*, store brand entry produces a structural change in performance. First, both brand share and revenue are classified as evolving by the ADF and the PP unit-root tests. The Perron tests confirm that a structural break occurred at the time of store brand entry. Both series are classified as stationary after allowing for this break. Second, the variance of all performance series shows a significant increase after store brand entry. Finally, Quaker's wholesale price variance shows a significant increase after store brand entry.

In contrast, the manufacturer performance series for *premium brand Nabisco* are all classified as stationary, while its wholesale price is classified as trend stationary (trending up). No variance change occurs for Nabisco's wholesale price, but its performance series do experience a variance increase after store brand entry.

[11] All unit-root and structural change tests are reported at the 5% significance level.

For the *retailer performance series*, category revenue, store traffic, and store revenue are stationary. In contrast, category sales experiences a structural break at store brand entry, and category margin shows a structural break eight weeks after store brand entry (as identified with the Zivot-Andrews test). We verified that this endogenously determined breakpoint is also valid for the other series, and use it, instead of the entry date, in subsequent analysis. The variance increases for all category performance series. As for pricing, Quaker's retail price is stationary, while Nabisco's retail price is trend stationary (trending up). The Brown-Forsythe test for retail price variance indicates an increase for both brands. Finally, feature and display activity do not show a structural break at store brand entry, but category product variety and average price do.

Toothbrush Category. Table 4 reports on the test results for the toothbrush category.

Second-tier brand Reach experiences a structural break in brand sales and brand revenue, and a significant increase in wholesale price variance. In contrast, manufacturer performance is stationary for *Colgate and premium brand Oral-B*. Moreover, wholesale price variance does not change with store brand entry. All three brands experience a structural change to product variety.

Table 4 Results of the Unit-Root and Structural Change Tests for the Toothbrush Category

Performance measure marketing variable	ADF unit-root test	Brown-Forsythe variance test	Phillips-Perron unit-root test	Perron structural break test	Zivot and Andrews test
Manufacturer ORAL-B					
Brand sales	Stationary	Decrease	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Brand shares (%)	Stationary	Increase	Stationary	Stationary	Stationary
Product variety	Evolving	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Stationary	No change	Stationary	Stationary	Stationary
Manufacturer REACH					
Brand sales	Evolving	No change	Evolving	Stationary	Stationary
Brand revenue ($)	Evolving	No change	Evolving	Stationary	Stationary
Brand shares (%)	Stationary	No change	Stationary	Stationary	Stationary
Product variety	Evolving	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Stationary	Increase	Stationary	Stationary	Stationary
Manufacturer COLGATE					
Brand sales	Stationary	No change	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	Increase	Stationary	Stationary	Stationary
Brand shares (%)	Stationary	Increase	Stationary	Stationary	Stationary
Product variety	Evolving	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Stationary	No change	Stationary	Stationary	Stationary
RETAILER					
Category sales	Stationary	No change	Stationary	Stationary	Stationary
Category revenue ($)	Stationary	No change	Stationary	Stationary	Stationary
Category margin ($)	Stationary	No change	Stationary	Stationary	Stationary
Store traffic (numbers)	Stationary	Increase	Stationary	Stationary	Stationary
Store revenue ($)	Stationary	Increase	Stationary	Stationary	Stationary
Retail price Oral-B ($)	Stationary	Increase	Stationary	Stationary	Stationary
Retail price Reach	Trend stationary	Increase	Trend stationary	Trend stationary	Trend stationary
Retail price Colgate ($)	Trend stationary	Increase	Trend stationary	Trend stationary	Trend stationary
Average price paid ($)	Evolving	Increase	Evolving	Stationary	Stationary
Feature Oral-B (%)	Stationary	No change	Stationary	Stationary	Stationary
Feature Reach (%)	Stationary	No change	Stationary	Stationary	Stationary
Feature Colgate (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Oral-B (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Reach	Stationary	No change	Stationary	Stationary	Stationary
Display Colgate (%)	Stationary	No change	Stationary	Stationary	Stationary
Category product variety	Evolving	Increase	Evolving	Stationary	Stationary

Turning to the retailer, all the performance series—category sales, category revenue, category margin, store traffic, and store revenue—are stationary. With respect to retail prices, prices of Colgate and Reach are trend stationary (trending up), while Oral-B's price is stationary. Feature and display activity are stationary, whereas category product variety and average price experience a structural break. Finally, retail price variance increases for all three brands.

Paper Towels Category. Table 5 reports on the test results for the paper towels category.

While *second-tier brand Scott's* share and revenue experience structural change, all manufacturer performance series are stationary for *premium brands Bounty and Viva*. Performance variance is lower for all three national brands. Wholesale price is stationary for all brands, whereas product variety experiences structural change for Scott and Bounty.

For the retailer, all category and store performance series are stationary. We also find that the retail prices of Bounty and Viva are stationary. Retail price variance increases for Bounty, decreases for Viva, and remains unchanged for Scott. Finally, feature and display activity, and average price, are stationary, whereas category product variety experiences a structural break at store brand entry.

Soap Category. Table 6 reports on the test results for the soap category.

Second-tier brand Ivory experiences a structural change to performance at store brand entry. Moreover, its wholesale price variance increases. In contrast, the other brands have stationary performance series. Wholesale price variance does not increase for Dove, and decreases for Lever 2000 and Dial.

Turning to the retailer, all the performance series—category sales, category revenue, category margin, store traffic, and store revenue—are stationary. With respect to retail prices, prices of Dial and Ivory are stationary, whereas prices of Dove and Lever 2000 experience a structural break. Retail price variance

Table 5 Results of the Unit-Root and Structural Change Tests for the Paper Towels Category

Performance measure marketing variable	ADF unit-root test	Brown-Forsythe variance test	Phillips-Perron unit-root test	Perron structural break test	Zivot and Andrews test
Manufacturer BOUNTY					
Brand sales	Stationary	Decrease	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Brand share (%)	Stationary	No change	Stationary	Stationary	Stationary
Product variety	Evolving	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Stationary	No change	Stationary	Stationary	Stationary
Manufacturer VIVA					
Brand sales	Stationary	Decrease	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Brand share (%)	Stationary	No change	Stationary	Stationary	Stationary
Product variety	Stationary	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Stationary	No change	Stationary	Stationary	Stationary
Manufacturer SCOTT					
Brand sales	Stationary	Decrease	Stationary	Stationary	Stationary
Brand revenue ($)	Evolving	Decrease	Evolving	Stationary	Stationary
Brand share (%)	Evolving	No change	Evolving	Stationary	Stationary
Product variety	Evolving	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Stationary	No change	Stationary	Stationary	Stationary
RETAILER					
Category sales	Stationary	No change	Stationary	Stationary	Stationary
Category revenue ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Category margin ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Store traffic (numbers)	Stationary	Increase	Stationary	Stationary	Stationary
Store revenue ($)	Stationary	Increase	Stationary	Stationary	Stationary
Retail price Bounty ($)	Stationary	Increase	Stationary	Stationary	Stationary
Retail price Viva ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Retail price Scott ($)	Evolving	No change	Evolving	Stationary	Stationary
Average price paid ($)	Stationary	No change	Stationary	Stationary	Stationary
Feature Bounty (%)	Stationary	No change	Stationary	Stationary	Stationary
Feature Viva (%)	Stationary	No change	Stationary	Stationary	Stationary
Feature Scott (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Bounty (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Viva (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Scott (%)	Stationary	No change	Stationary	Stationary	Stationary
Category product variety	Evolving	No change	Evolving	Stationary	Stationary

increases only for Ivory. Again, feature and display activity, and average price, are stationary, whereas category product variety experiences a structural break.

In summary, the unit-root and structural break tests indicate that store brand entry does create a persistent, structural change in at least some performance and price variables in all four categories. Closer inspection reveals systematic variation in these structural change findings. On the one hand, *second price-tier brands such as Quaker hot breakfast cereal, Reach toothbrushes, Scott paper towels, and Ivory soap experience a structural change in their sales and revenues*. Moreover, Quaker, Reach, and Ivory increase their wholesale price variance, suggesting a structural increase in their price promotional frequency to the retailer. This finding is consistent with Narasimhan and Wilcox's (1998) assertion that store brands improve the bargaining position of the retailer vis-à-vis the manufacturer. On the other hand, the manufacturers of premium brands in all four categories—Nabisco, Oral-B, Bounty and Viva, Dove and Lever 2000—do not see a structural change in performance nor an increase in the wholesale price variance. Moreover, some second-tier brands (Colgate and Dial) do not experience structural change either. *From the retailer's perspective, only the hot breakfast cereal category experiences a significant structural change in category sales and category gross margin*. From the consumer's perspective, product variety, but not average price paid, experiences a structural break for all categories. To assess the extent of the reported changes after store brand entry, we next turn to estimating the VARX models.

5.2. Parameter Stability Tests of the VARX Models

The parameter stability tests for the full-period vector autoregressive models represent a multivariate test on structural change at the time of store brand entry. The Wald tests[12] show that structural shifts occur

[12] Detailed results are available upon request from the authors.

Table 6 Results of the Unit-Root and Structural Change Tests for the Soap Category

Performance measure marketing variable	ADF unit-root test	Brown-Forsythe variance test	Phillips-Perron unit-root test	Perron structural break test	Zivot and Andrews test
Manufacturer DOVE					
Brand sales	Stationary	No change	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	No change	Stationary	Stationary	Stationary
Brand share (%)	Stationary	No change	Stationary	Stationary	Stationary
Product variety	Stationary	No change	Stationary	Stationary	Stationary
Wholesale price ($)	Stationary	No change	Stationary	Stationary	Stationary
Manufacturer LEVER 2000					
Brand sales	Stationary	No change	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Brand share (%)	Stationary	Decrease	Stationary	Stationary	Stationary
Product variety	Evolving	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Evolving	Decrease	Evolving	Stationary	Stationary
Manufacturer DIAL					
Brand sales	Stationary	No change	Stationary	Stationary	Stationary
Brand revenue ($)	Stationary	No change	Stationary	Stationary	Stationary
Brand share (%)	Stationary	No change	Stationary	Stationary	Stationary
Product variety	Evolving	No change	Evolving	Stationary	Stationary
Wholesale price ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Manufacturer IVORY					
Brand sales	Evolving	No change	Stationary	Stationary	Stationary
Brand revenue ($)	Evolving	Decrease	Evolving	Stationary	Stationary
Brand share (%)	Stationary	No change	Stationary	Stationary	Stationary
Product variety	Stationary	No change	Stationary	Stationary	Stationary
Wholesale price ($)	Stationary	Increase	Stationary	Stationary	Stationary
RETAILER					
Category sales	Stationary	Decrease	Stationary	Stationary	Stationary
Category revenue ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Category margin ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Store traffic (numbers)	Stationary	No change	Stationary	Stationary	Stationary
Store revenue ($)	Stationary	No change	Stationary	Stationary	Stationary
Retail price Dove ($)	Evolving	No change	Evolving	Stationary	Stationary
Retail price Lever 2000	Evolving	Decrease	Stationary	Stationary	Stationary
Retail price Dial ($)	Stationary	Decrease	Stationary	Stationary	Stationary
Retail price Ivory ($)	Stationary	Increase	Stationary	Stationary	Stationary
Average price paid ($)	Stationary	No change	Stationary	Stationary	Stationary
Feature Dove (%)	Stationary	Decrease	Stationary	Stationary	Stationary
Feature Lever 2000 (%)	Stationary	Decrease	Stationary	Stationary	Stationary
Feature Dial (%)	Stationary	Decrease	Stationary	Stationary	Stationary
Feature Ivory (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Dove (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Lever 2000 (%)	Stationary	No change	Stationary	Stationary	Stationary
Display Ivory (%)	Stationary	Increase	Stationary	Stationary	Stationary
Category product variety	Evolving	No change	Evolving	Stationary	Stationary

in the data-generating process of virtually all performance variables. Therefore, we capture all these changes by estimating pre- and postentry VARX models separately to compare the multivariate equilibrium levels and the long-term consumer and competitive response estimates. The former reveal who is better off after store brand entry; the latter indicate how consumer and competitive response are different in the pre- and postentry periods. The pre- and postentry equilibrium levels are reported in Tables 7–10 for the four categories. Our discussion focuses on the changes for the manufacturers, for the retailer, and for the consumers.

5.3. Do the Manufacturers Benefit from Store Brand Entry?

Hot Breakfast Cereal Category. The pre- and post-equilibrium levels of manufacturer performance are reported in Table 7. First, we find that Quaker's share and revenue experience a *permanent*, structural change after store brand entry: Its weekly revenues decline from $44,435 to $36,200. In contrast, Nabisco's performance is slightly improved after store brand entry, for both sales and revenue. The sales results occur despite Quaker's lower (wholesale and retail) prices after store brand entry, and despite Nabisco's higher (wholesale and retail) prices. Both changes

Table 7 Weekly Equilibrium Levels of Performance and Marketing for Hot Breakfast Cereal[1]

Performance measure marketing variable	Pre-entry equilibrium level	Postentry equilibrium level	*t*-Value for the difference in the pre- and postentry levels
Manufacturer NABISCO			
Brand sales (in 10 of oz)	7,166	7,306	0.61
Brand revenue ($)	7,284	7,814	1.97**
Brand share (%)	11	12	0.62
Wholesale price ($)	1.02	1.09	1.71*
Manufacturer QUAKER			
Brand sales (in 10 of oz)	49,937	46,674	−1.98**
Brand revenue ($)	44,435	36,205	−4.95***
Brand share (%)	80	69	−2.11**
Wholesale price ($)	0.88	0.80	−1.79*
RETAILER			
Category sales (in 10 of oz)	62,657	65,744	1.83*
Category revenue ($)	68,240	65,600	−0.52
Category margin ($)	13,039	15,810	2.45***
Store traffic (numbers)	2,027,918	1,870,752	−0.74
Store revenue ($)	40,311,760	38,346,682	−0.56
Retail price in $ (Nabisco)	1.28	1.41	2.14**
Retail price in $ (Quaker)	1.09	1.05	−0.90
Retail price in $ (Store)		0.80	
Promotional depth in % (Nabisco)	16	16	
Promotional depth in % (Quaker)	14	17	
Promotional depth in % (Store)		13	
Promotional frequency (Nabisco)	0.10	0.17	
Promotional frequency (Quaker)	0.08	0.11	
Promotional frequency (Store)		0.15	
Average price paid ($)	1.09	1.04	
Product variety (# UPCs)			
Nabisco	10	12	
Quaker	31	34	
Store		6	
Feature (% featured)			
Nabisco	6.3	3.6	
Quaker	10.3	2.2	
Store		10.3	
Display (% displayed)			
Nabisco	0.40	1.7	
Quaker	0.60	2.6	
Store		5.8	

[1]Because all series are stationary after allowing for the structural break, these multivariate equilibrium levels equal the mean of each series in each period.

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

are in line with our expectations for second-tier and premium brands. On the one hand, Quaker now directly competes with an entrant that is both lower priced and favored by the retailer in terms of feature and display activity. On the other hand, premium brand Nabisco gradually increases price (by introducing higher-priced varieties) without incurring volume loss. The implied decrease in price sensitivity is formally tested below.

Toothbrush Category. Table 8 shows that second-tier brand Reach is adversely affected on all three performance measures—sales, share, and revenue. Its (wholesale and retail) price increases, and its product assortment grows by 10 SKUs. In contrast, premium brand Oral-B's performance is slightly higher in the postentry period. Oral-B introduced a large number of product-line extensions, increasing its product assortment by 16 SKUs. Finally, Colgate's performance remains unaffected despite a modest price increase. A possible rationale is the strong increase in product variety by 13 SKUs. Overall, only Reach—but not Colgate or Oral-B—is worse off after store brand entry. Interestingly, the retailer does not appear to

Table 8 Weekly Equilibrium Levels of Performance and Marketing Series in the Toothbrush Category

Performance measure marketing variable	Pre-entry equilibrium level	Postentry equilibrium level	*t*-Value for the difference in the pre- and postentry levels
Manufacturer ORAL-B			
Brand sales	2,357	2,470	1.96**
Brand revenue ($)	3,422	3,471	1.45
Brand shares (%)	20.9	21.6	1.03
Wholesale price ($)	1.44	1.41	−0.78
Manufacturer REACH			
Brand sales	2,623	1,882	−2.67**
Brand revenue ($)	2,990	2,220	−2.43**
Brand shares (%)	23.2	16.5	−2.17**
Wholesale price ($)	1.14	1.18	1.61
Manufacturer COLGATE			
Brand sales	3,115	2,950	−1.29
Brand revenue ($)	3,160	3,251	1.74*
Brand share (%)	27.6	25.7	−1.54
Wholesale price ($)	1.01	1.10	1.00
Manufacturer STORE BRAND			
Brand sales		1,000	
Brand revenue ($)		316	
Brand shares (%)		8.7	
Wholesale price ($)		0.37	
RETAILER			
Category sales	11,280	11,430	0.63
Category revenue ($)	19,005	19,728	0.72
Category margin ($)	7,164	7,550	0.93
Store traffic (numbers)	1,870,000	1,930,000	1.01
Store revenue ($)	40,420,000	39,200,000	−1.24
Retail price in $ (Oral-B)	2.14	2.17	0.65
Retail price in $ (Reach)	1.69	1.96	1.98**
Retail price in $ (Colgate)	1.67	1.90	1.81**
Retail price in $ (Store)		1.15	
Promotional depth in % (Oral-B)	1	8	
Promotional depth in % (Reach)	3	9	
Promotional depth in % (Colgate)	1	4	
Promotional depth in % (Store)		8	
Promotional frequency (Oral-B)	0.02	0.05	
Promotional frequency (Reach)	0.06	0.10	
Promotional frequency (Colgate)	0.06	0.05	
Promotional frequency (Store)		0.07	
Average price paid ($)	1.76	1.73	
Product variety (# UPCs)			
Oral-B	24	40	
Reach	13	23	
Colgate	22	35	
Store		7	
Feature (% featured)			
Oral-B	4.3	6.5	
Reach	3.0	8.1	
Colgate	3.3	6.4	
Store		2.6	
Display (% displayed)			
Oral-B	7.7	7.7	
Reach	2.5	1.3	
Colgate	2.2	3.2	
Store		2.2	

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

favor the store brand in terms of feature and display decisions. Apparently product innovation plays a major role in the toothbrush category,[13] and Colgate and Oral-B seem to have done a better job than Reach in this respect.

[13] Studies by Colgate show that toothbrushes is one of the few supermarket categories in which consumers feel that substantial product improvement has occurred in the nineties and still expect substantial future improvements (personal conversation with Jim Figura, Vice President of Consumer Insights, Colgate).

Table 9 Weekly Equilibrium Levels of Performance and Price Series in the Paper Towels Category

Performance measure marketing variable	Pre-entry equilibrium level	Postentry equilibrium level	*t*-Value for the difference in the pre- and postentry levels
Manufacturer BOUNTY			
Brand sales	39,900	42,250	1.92*
Brand revenue ($)	31,860	35,870	2.21**
Brand share (%)	20	27	1.99**
Wholesale price ($)	0.81	0.87	1.67*
Manufacturer VIVA			
Brand sales	22,660	23,110	1.02
Brand revenue ($)	17,560	16,500	−1.45
Brand share (%)	11	14	1.59
Wholesale price ($)	0.78	0.73	−1.12
Manufacturer SCOTT			
Brand sales	48,970	32,000	−2.46***
Brand revenue ($)	35,680	22,620	−3.49***
Brand share (%)	25	20	−2.11**
Wholesale price ($)	0.74	0.71	−1.66*
Promotional frequency			
Manufacturer STORE			
Brand sales		12,370	
Brand revenue ($)		4,190	
Brand share (%)		8	
Wholesale price ($)		0.34	
RETAILER			
Category sales	198,900	161,380	−1.61
Category revenue ($)	155,780	121,490	−1.44
Category margin ($)	24,720	19,150	−1.33
Store traffic (numbers)	1,958,380	1,940,800	−1.03
Store revenue ($)	40,876,690	38,870,000	−1.01
Retail price in $ (Bounty)	0.94	1.01	1.69*
Retail price in $ (Viva)	0.91	0.87	−0.71
Retail price in $ (Scott)	0.85	0.81	−0.65
Retail price in $ (Store)		0.50	
Promotional depth in % (Bounty)	5	7	
Promotional depth in % (Viva)	18	12	
Promotional depth in % (Scott)	9	9	
Promotional depth in % (Store)		19	
Promotional frequency (Bounty)	0.02	0.07	
Promotional frequency (Viva)	0.08	0.09	
Promotional frequency (Scott)	0.07	0.15	
Promotional frequency (Store)		0.11	
Average price paid ($)	0.83	0.93	
Product Variety (# UPCs)			
Bounty	7	15	
Viva	40	43	
Scott	11	26	
Store		5	
Feature (% featured)			
Bounty	12.7	6.0	
Viva	12.6	4.4	
Scott	18.1	9.3	
Store		15.0	
Display (% displayed)			
Bounty	1.7	4.8	
Viva	0.8	1.6	
Scott	1.7	3.3	
Store		2.0	

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

Paper Towel Category. Table 9 shows that manufacturer performance decreases for second-tier brand Scott, but not for premium brands Bounty nor Viva. Scott loses five share points and manufacturer revenue decreases despite a price decrease and a spectacular increase in product variety from 11 to 26 SKUs. We infer that Scott is mainly introducing lower-priced varieties, in contrast to Bounty, which doubles its assortment with higher-priced varieties. As in the hot breakfast cereal category, the retailer clearly favors her own brand in terms of feature activity: The store brand becomes the most featured brand

and all national brands, especially Scott, lose in this respect.

Soap Category. Table 10 shows that second-tier brand Ivory is adversely affected on sales and revenue. In contrast, premium brand Dove's performance is slightly higher in the postentry period, despite a modest price increase. Dove sees an increase in SKUs from 8 in the preentry period to 13 in the postentry period. Lever 2000 shows a similar pattern, increasing its assortment from 2 to 9 SKUs. Interestingly, second-tier brand Dial doubles its assortment and does not experience performance decline. Here too, as in the toothbrush category, product variety plays a major role with Dove, Lever 2000, and Dial doing a better job than Ivory.

In sum, our results indicate that there are significant differences among brands in terms of the effects of store brand entry on manufacturer performance—entry is *beneficial* to some brands and *detrimental* to

Table 10 Weekly Equilibrium Levels of Performance and Price Series in the Soap Category

Performance measure/ marketing variable	Pre-entry level	Postentry level	*t*-Value for the difference in the pre- and postentry levels
Manufacturer DOVE			
Brand sales	5,875	6,024	1.67*
Brand revenue ($)	9,800	10,283	1.68*
Brand share (%)	9	11	1.64
Wholesale price ($)	1.68	1.71	0.70
Manufacturer LEVER 2000			
Brand sales	4,340	4,490	0.39
Brand revenue ($)	4,750	5,160	0.84
Brand shares (%)	7.0	7.7	1.42
Wholesale price ($)	1.09	1.16	0.92
Manufacturer DIAL			
Brand sales	10,022	9,985	−0.43
Brand revenue ($)	9,950	10,065	1.12
Brand shares (%)	16.2	17.2	1.84*
Wholesale price ($)	0.99	0.99	0.06
Manufacturer IVORY			
Brand sales	4,545	3,880	−1.98**
Brand revenue ($)	3,940	3,185	−1.85*
Brand share (%)	7	7	0.05
Wholesale price ($)	0.86	0.87	0.40
Manufacturer STORE BRAND			
Brand sales		723	
Brand revenue ($)		751	
Brand share (%)		1	
Wholesale price ($)		0.48	
RETAILER			
Category sales	62,220	57,855	−1.59
Category revenue ($)	84,340	78,215	−1.35
Category margin ($)	20,180	19,300	−1.22
Store traffic (numbers)	1,952,100	1,852,100	−1.63
Store revenue ($)	39,096,040	38,217,200	−1.22
Retail price in $ (Dove)	2.17	2.25	1.69*
Retail price in $ (Lever 2000)	1.45	1.50	0.46
Retail price in $ (Dial)	1.34	1.32	−0.70
Retail price in $ (Ivory)	1.11	1.14	1.10
Retail price in $ (Store)		1.03	
Promotional depth in % (Dove)	9	8	
Promotional depth in % (Lever 2000)	18	15	
Promotional depth in % (Dial)	13	8	
Promotional depth in % (Ivory)	17	6	
Promotional depth in % (Store)		6	
Promotional frequency (Dove)	0.10	0.15	
Promotional frequency (Lever 2000)	0.12	0.11	
Promotional frequency (Dial)	0.17	0.09	
Promotional frequency (Ivory)	0.12	0.07	
Promotional frequency (Store)		0.07	
Average price paid ($)	1.36	1.35	

Table 10 (cont'd.).

Performance measure/ marketing variable	Pre-entry level	Postentry level	*t*-Value for the difference in the pre- and postentry levels
Product variety (# UPCs)			
Dove	8	13.1	
Lever 2000	2	9	
Dial	16.5	31	
Ivory	5	8.2	
Store		1	
Feature (% featured)			
Dove	18.4	8.6	
Lever 2000	3	6	
Dial	1	2	
Ivory	3	2	
Store		5	
Display (% displayed)			
Dove	2	1	
Lever 2000	2	2	
Dial	1	2	
Ivory	1	3	
Store		5	

*Significant at the 10% level; **significant at the 5% level; ***significant at the 1% level.

others. A striking consistency across the four categories is that *store brand entry is typically beneficial for premium price* national brands (Nabisco, Oral-B, Bounty and Viva, Dove and Lever 2000), but not for *second price-tier* national brands: Quaker, Reach, Scott, and Ivory lose, whereas the performance of Colgate and Dial is unaffected. These results largely confirm Hypotheses 4–6. In particular, note that the premium-price brands are able to maintain or even increase market share, often despite higher prices, while most second-tier brands lose market share, often despite lower prices. Overall, most incumbents behave according to Gruca et al. (2001) and their prescriptions for situations without complete segment overlap.

On the one hand, *premium brands accommodate* store brand entry in the price variable: retail and wholesale prices increase. On the other hand, *second price-tier brands typically retaliate against store brand entry with lower prices and/or increased promotional activity*. Previous findings in line with our results include Hoch and Banerji (1993) and Ailawadi et al. (2001). According to Quelch and Harding (1996), Procter and Gamble phased out White Cloud toilet tissue and Oxydol because these second-tier brands could not profitably compete with the store brand. The notable exceptions in our dataset are Colgate and Dial, which raise average price by successfully introducing higher-priced varieties and maintain performance in the postentry period. These observations reflect the recommendation by Tyagi and Raju (2001) that incumbent national brands should focus on differentiation when faced with store brand entry.

5.4. Does the Retailer Benefit from Store Brand Entry?

Hot Breakfast Cereal Category. Table 7 shows the pre- and postequilibrium levels of retailer performance for the hot breakfast cereal category. Consistent with the unit-root and structural break tests, category sales and category margin increase after store brand entry. The increase in category margin is due to the increased margin on the store brand as well as to the lower wholesale price that Quaker charges the retailer. The retailer unit margin on premium brand Nabisco also increases, as the wholesale price increases less than the retail price does. There are no effects of store brand entry on store performance—store revenue and store traffic are relatively stable in the pre- and postentry periods. Apparently, the revenue increase in the hot breakfast cereal category is (1) not sufficient to significantly increase store revenue or (2) is a result of category switching.

Toothbrush Category. Table 8 shows that all retailer performance series are relatively stable for the toothbrush category. In the postentry period, the category margin is slightly higher, reflecting significantly increased unit margins on all national brands, category sales, and category revenues. These changes occur gradually, as the unit-root test did not show a structural change at store brand entry.

Paper Towels Category. Similar to the toothbrush category, we find no structural change in any retailer performance measure due to store brand entry. Table 9 shows that all retailer performance series are lower for the paper towel category in the postentry

period. Category margin decreases despite significantly higher unit margins on premium brands Bounty and Viva (the retailer unit margin decrease for Scott is insignificant). The key reason is the decline in category sales, which is not offset by increased retail prices of the brands in this category. These changes occur gradually as the unit-root test did not show a structural break at store brand entry.

Soap Category. Table 10 shows that all retailer performance series are relatively stable for the soap category. In the postentry period, category sales and revenues are slightly lower. As in the case of toothbrushes and paper towels, these changes occur gradually and are not significant. Unit margins are significantly higher for Dove and Ivory, but not for Lever 2000 and Dial.

In summary, we find support for Hypothesis 1: Store brand entry structurally benefits the retailer by *increasing unit margins on national brands in all four categories*. In the case of increasing wholesale prices, retail prices increased more. In the case of decreasing wholesale prices, retail prices decreased less. Only 2 out of 12 national brands did not experience increased retailer unit margin in the postentry period. However, these increased unit margins do not translate into structurally higher retailer performance in the toothbrush, paper towels, and soap categories. For all three nonfood categories, *neither category sales nor retailer gross category margin significantly increases in the postentry period*.

In contrast, both primary demand and retailer category margin increase for the hot breakfast cereal category. This intriguing difference could be due to characteristics of the store brand, the product category, or the competitive reactions. First, the store brand itself is only expected to increase category demand if it is more attractive than the best incumbent brand for a substantial number of shoppers (Mason 1990). Second, consumption appears more flexible in a food category such as hot breakfast cereal, as consumers can easily substitute away from other food products (Bell et al. 1999, Ailawadi and Neslin 1998). Third, the hot breakfast cereal category shows the largest decrease in average price paid after store brand entry, which provides an additional motivation for category expansion. Moreover, competitive forces besides store brand entry may drive category performance such as product innovation, combined with higher prices, in the nonfood categories.

Finally, *store brand entry does not have a significant effect on store traffic and store revenue for any category*. While this finding is expected (Walters and MacKenzie 1988), it remains possible that store brands have an effect in aggregate across categories on store traffic.[14] Overall, our results suggest that while the entry of a store brand is a profit contributor, taking advantage of the lower variables costs and higher per-unit margins (Hoch and Lodish 2003), these category benefits are insufficient to significantly increase traffic building or revenues at the store level.

5.5. Does Long-Term Price Sensitivity Differ After Store Brand Entry?

Based on the preentry and postentry VARX models, we estimate the long-term response of brand volume[15] to a price shock by, respectively, each national brand and the store brand. Table 11 reports these long-term elasticities, reversing the sign for ease of interpretation (i.e., higher value for higher price sensitivity).

Hot Breakfast Cereal Category. After store brand entry, the brand volume price elasticity is significantly higher for Quaker and other brands, but significantly lower for premium brand Nabisco. These findings are consistent with the lower price for Quaker and the higher price for Nabisco after store brand entry.

Toothbrush Category. Consistent with the hot breakfast cereal category, Table 11 shows increased brand volume price sensitivity for second-tier brand Colgate and other, but not for premium brand Oral-B. Surprisingly, second-tier brand Reach does not experience increased price sensitivity.

Paper Towels Category. Consistent with the hot breakfast cereal and toothbrush categories, brand volume elasticities increase for second-tier brands Scott and other, but decrease for premium brands Bounty and Viva.

Soap Category. Brand volume elasticity decreases for premium brands Dove and Lever 2000, but increases for second-tier brand Ivory. Similar increases for second-tier brands Dial and other are not significant.

In summary, we find that *long-term brand sales response* to price shocks changes consistently after store brand entry. *Premium brands maintain or even decrease price sensitivity, whereas second-tier brands typically experience increased price sensitivity*, although such change is not always statistically significant. On the other hand, changes to the price response of other performance variables are typically insignificant.

[14] Studying the impact of store brands in aggregate across categories on store traffic is a useful direction for future research.

[15] Detailed results for the long-term response of the other performance variables are available upon request from the authors.

Table 11 Long-Term Price Promotional Elasticity*

	Hot breakfast cereal		Toothbrush		Paper towel		Soap	
	Pre-entry	Post-entry	Pre-entry	Post-entry	Pre-entry	Post-entry	Pre-entry	Postentry
Premium brand I	5.01	3.50	1.77	2.21	4.49	3.20	6.61	2.30
(*t*-value Δ)	(−2.34)		(0.67)		(−2.10)		(−5.83)	
Premium brand II					6.17	4.20	4.79	1.81
(*t*-value Δ)					(−0.97)		(−3.83)	
Second-tier brand I	4.45	5.23	2.74	2.11	0.98	2.00	2.16	3.10
(*t*-value Δ)	(1.66)		(−0.97)		(1.96)		(1.78)	
Second-tier brand II			−0.31	1.99			1.22	3.64
(*t*-value Δ)			(3.96)				(4.90)	
Other brands	0.66	1.71	−0.19	1.87	1.46	5.02	0.89	1.17
(*t*-value Δ)	(2.82)		(4.14)		(5.13)		(1.72)	
Store brand		2.31		2.24		4.86		3.48
(*t*-value)	(7.22)		(10.67)		(7.15)		(2.66)	

*Premium brand I = Nabisco, Oral-B, Bounty, Dove; Premium brand II = Viva, Lever 2000; Second-tier brand I = Quaker, Reach, Scott, Dial; Second-tier brand II = Colgate, Ivory.

5.6. Does the Consumer Benefit from Store Brand Entry?

Based on the information in our dataset, consumers may benefit from store brand entry in three ways. First, category choice may increase as more product varieties are offered in the postentry environment. Second, retail prices on national brands may decrease. Finally, increased promotions for national brands and the low store brand price may decrease actual price paid in the category, as consumers can switch to cheaper alternatives when they see fit.

Hot Breakfast Cereal Category. Table 7 shows that consumers enjoy increased product variety in the postentry period as both national brands offer more product varieties and the store brand becomes available in six versions. Moreover, second-tier brand Quaker's retail price is lower after store brand entry and the store brand is cheaper than either national brand. In contrast, premium brand Nabisco's retail price is higher in the postentry period. Finally, price promotional depth and frequency increases for both national brands. As a net result of these phenomena, average price paid is 5% lower in the postentry period. The structural increase in category demand is consistent with both increased product variety and the lower prices paid in this category.

Toothbrush Category. Just as in the hot breakfast cereal category, product variety is higher after store brand entry in the toothbrush category. Table 8 reveals a spectacular increase: All three national brands almost doubled their number of SKUs in the postentry period. As a result, the total product variety in the toothbrush category increased 80%; from 59 in the preentry period of the store brand to 105 in the postentry period. Retail prices are higher for all national brands. Together with the stable category sales, this phenomenon indicates that the national brands introduced higher (perceived) quality versions, for which consumers were willing to pay higher prices. On the other hand, price promotional-depth is higher for all brands, and price promotional frequency increases for Oral-B and Reach. Together with the success of the lower-priced store brand, this change accounts for a reduction in average price paid in the category.

Paper Towels Category. Table 9 shows that product variety increases for paper towels too. Both Bounty and Scott more than double their product assortment, while the store brand is offered in five versions. Retail prices are lower for Scott and Viva, but higher for Bounty in the postentry period. Price promotional frequency is higher for all brands, but price-promotional depth increases for Bounty and decreases for Viva. As a net result, average price paid is 12% higher, and category sales are 19% lower in the postentry period. Considering their net impact on average price, high-priced product introductions played a larger role in the paper towels category than store brand entry did.

Soap Category. Table 10 shows that consumers enjoy increased product variety in the postentry period. Retail prices are slightly higher in the postentry period for all national brands except Dial. Price-promotional depth is lower for all brands, whereas frequency increases for Dove but decreases for the other brands. As in the toothbrush category, national brands introduce higher (perceived) quality versions, for which consumers are willing to pay more. The net result after store brand entry is a very slight decrease in the average price paid in the category.

In sum, our results indicate that there are some beneficial effects of store brand entry for consumers. First,

in support of Hypothesis 10, *product variety increases in all four categories, including more versions of all national brands.* Second, average price paid is lower after store brand entry in three categories (Hypothesis 9). Third, in support of Hypothesis 8, retail prices only decrease for some second-tier brands, not for premium brands. This outcome logically follows from the increased price sensitivity estimates for second-tier brands after store brand entry. In contrast, price sensitivity typically decreases for the premium brands, in support of Hypothesis 7. The net result of these changes is a slight reduction in average price paid for hot cereal (−4.5%), toothbrushes (−1.8%), and soap (−0.7%). These results closely reflect the simulations of Gruca et al. (2001), which predict average price decreases of between 0.4% and 3.6% for a market with four incumbents. In contrast, the average price-paid increases for paper towels (+12%) is driven exclusively by the increased popularity and price of Bounty (all other brands decreased their price).

5.7. Validation of the Results

Contrast with Categories Without Store Brand Entry. We acknowledge that care is needed in the interpretation of the VARX results of changes to equilibrium levels and to promotional response. After all, several exogenous factors may have caused the reported differences between the periods before and after store brand entry. For instance, consumers may have become more price sensitive over time (Mela et al. 1997), their demographic and psychological profile may have changed, as could their patronage among stores. As a result, the reported changes in financial performance variables may be due to maturation factors that affect all categories in the retail chain. Therefore, we validate our findings by estimating split-half VARX models and their associated impulse-response functions for the 20 categories that do not feature store brand entry. If general maturation factors are responsible for the observed changes in the store brand entry categories, we should observe a similar change in mean performance and promotional response of the other categories.

Table 12a shows the mean results for the split-half (before versus after 11/25/1993) estimates of the multivariate equilibrium levels for these 20 categories. No patterns emerge for manufacturer revenues or for retailer category revenues. Interestingly, retailer category margin is on average lower in the second half of the data period for the categories without store brand entry. In contrast, two out of four categories with store brand entry, hot breakfast cereal and toothbrushes, show increased retailer margin. Table 12b shows the mean results for the split-half (before versus after 11/25/1993) estimates of long-term price response for the 20 categories without store brand entry. Note that the promotional impact on all performance variables is slightly higher in the latter half of the data period. This trend is directionally similar to that observed for some second-tier brands, but not to that observed for premium brands confronted with store brand entry. Finally, Table 12c shows that the average increase in product variety is 22% for the 20 control categories versus 64% for the 4 categories with store brand entry.

In summary, we observe that the reported changes in categories with store brand entry do not generally apply to the categories without store brand entry.

Pooling vs. Aggregation. Finally, we guard against aggregation bias by performing a pooling test and by estimating a pooled fixed-effect model (FEM) that accommodates heterogeneity among stores (e.g., Horváth and Wierenga 2002) to validate our chain-level findings. The pooling test fails to reject the

Table 12 Validation for the 20 Categories* Without Store Brand Entry: Mean (Standard Deviation)

Measure	Sample 1**	Sample 2**
a. Estimates of the multivariate equilibrium levels		
Manufacturer revenue (Brand 1)	67,455 (67,060)	66,980 (74,002)
Manufacturer revenue (Brand 2)	43,080 (61,709)	47,000 (83,098)
Manufacturer revenue (Brand 3)	17,825 (27,398)	18,440 (27,729)
Retailer category revenue	254,420 (232,409)	247,455 (251,493)
Retailer category margin	52,830 (45,259)	39,640 (42,486)
b. Estimates of long-term price response		
Long-term price sensitivity	3.86 (3.34)	4.34 (3.50)
c. Product innovation		
Category product assortment	9,000 (395)	10,980 (590)

*The manufacturer revenues are reported for the top three brands in the 20 categories which are analgesics, beer, bottled juice, cheese, cookies, crackers, canned soup, dish detergent, frozen dinner, frozen juice, fabric softeners, laundry detergents, front-end candies, refrigerated juice, soft drinks, shampoos, snack crackers, toilet tissue, toothpaste, and canned tuna.

**More precisely, the first sample is from the starting date for each category until 11/25/1993, while Sample 2 is from 11/25/1993 to the ending date of each category.

Table 13 Validation with Results Derived with Pooled VAR Model: Summary of Hypotheses, Percentage of Brands, [t-Values]

	Focal model	Pooled model
1. Category expansion for the retailer (H2)		
Hot breakfast cereal	Yes [1.83]	Yes [1.94]
Toothbrush	No [0.63]	No [0.86]
Paper towels	No [−1.61]	No [−1.62]
Soap	No [−1.59]	No [−1.53]
2. Higher category margin for the retailer (H3)		
Hot breakfast cereal	Yes [2.45]	Yes [2.89]
Toothbrush	No [0.93]	No [−1.07]
Paper towels	No [−1.33]	No [−1.59]
Soap	No [−1.22]	No [−0.11]
3. Premium brands maintain/increase share (H4a)		
Hot breakfast cereal	Yes, 100% [0.62]	Yes, 100% [1.42]
Toothbrush	Yes, 100% [1.03]	Yes, 100% [1.26]
Paper towels	Yes, 100% [1.99, 1.59]	Yes, 100% [2.14, 1.43]
Soap	Yes, 100% [1.64, 1.42]	Yes, 100% [1.15, 1.59]
4. Second-tier brands lose share (H4b)		
Hot breakfast cereal	Yes, 100% [−2.11]	Yes, 100% [−2.28]
Toothbrush	Yes, 50% [−2.17, −1.54]	Yes, 50% [−2.34, −1.48]
Paper towels	Yes, 100% [−2.11]	Yes, 100% [−2.61]
Soap	No, 0% [1.84, 0.05]	No, 0% [1.92, 0.49]
5. Premium brands maintain/increase wholesale price (H5a)		
Hot breakfast cereal	Yes, 100% [1.71]	Yes, 100% [1.68]
Toothbrush	Yes, 100% [−0.78]	Yes, 100% [−1.62]
Paper towels	Yes, 100% [1.67, −1.12]	Yes, 100% [1.66, −1.44]
Soap	Yes, 100% [0.70, 0.92]	Yes, 100% [0.72, 1.57]
6. Second-tier brands cut wholesale price (H5b)		
Hot breakfast cereal	Yes, 100% [−1.79]	Yes, 100% [−1.93]
Toothbrush	No, 0% [1.61, 1.00]	No, 0% [1.74, 1.40]
Paper towels	Yes, 100% [−1.66]	Yes, 100% [−1.87]
Soap	No, 0% [0.06, 0.40]	No, 0% [0.09, 0.72]
7. Premium brands maintain/increase revenue (H6a)		
Hot breakfast cereal	Yes, 100% [1.97]	Yes, 100% [2.06]
Toothbrush	Yes, 100% [1.45]	Yes, 100% [1.69]
Paper towels	Yes, 100% [2.21, −1.45]	Yes, 100% [2.44, −1.28]
Soap	Yes, 100% [1.68, 0.84]	Yes, 100% [1.82, 0.67]
8. Second-tier brands lose revenue (H6b)		
Hot breakfast cereal	Yes, 100% [−4.95]	Yes, 100% [−6.01]
Toothbrush	Yes, 50% [−2.43, 1.74]	Yes, 100% [−2.84, 1.79]
Paper towels	Yes, 100% [−3.49]	Yes, 100% [−3.66]
Soap	Yes, 50% [1.12, −1.85]	Yes, 50% [0.09, −1.74]
9. Premium brands have same/lower price sensitivity (H7a)		
Hot breakfast cereal	Yes, 100% [−2.34]	Yes, 100% [−7.50]
Toothbrush	Yes, 100% [0.67]	Yes, 100% [0.02]
Paper towels	Yes, 100% [−2.10, −1.98]	Yes, 100% [−3.17, −1.90]
Soap	Yes, 100% [−5.83, −3.83]	Yes, 100% [−6.71, −3.92]
10. Second-tier brands have higher price sensitivity (H7b)		
Hot breakfast cereal	Yes, 100% [1.66]	Yes, 100% [6.72]
Toothbrush	Yes, 67% [−0.97, 3.96]	Yes, 67% [−0.66, 7.84]
Paper towels	Yes, 100% [1.96]	Yes, 100% [6.37]
Soap	Yes, 100% [1.78, 4.90]	Yes, 100% [4.28, 5.95]

assumption of homogeneity across stores ($p < 0.05$) in all instances. Moreover, the FEM results,[16] summarized in Table 13, indicate that only one hypothesis gains additional support (H6b), while no additional evidence is found counter to the hypotheses. The robustness of our substantive findings to pooling across stores is in line with (1) our choice of a linear model which has been shown to be the least sensitive to the store aggregation issue (e.g., Christen et al.

[16] Detailed results from the fixed-effect pooled model are available upon request from the authors.

1997) and (2) assertions of limited heterogeneity in marketing activity (Allenby and Rossi 1991) as "DFF conducts a chainwide promotional strategy in which prices are lowered by a uniform percentage across all stores in the chain." (See, e.g., Hoch et al. 1995, p. 28.)

6. Conclusions

In this paper, we have investigated the impact of store brand entry on manufacturers, retailers, and consumers using data from four product categories over several years. To the best of our knowledge, this is the first study to assess the impact of store brand entry with convergent evidence from modern time-series techniques. Specifically, both the structural break unit-root tests and the VARX parameter stability tests show that structural change occurred at the time of store brand entry in the four categories. We group our findings on the beneficial effects of store brand entry for manufacturers, the retailer, and consumers, and summarize as follows:

For the *manufacturers*, store brand entry is typically beneficial for *premium-price* national brands, but not for *second price-tier* brands. Interestingly, the premium brands accommodate store brand entry in the price variable; both retail and wholesale prices increase. Revenues improve because this price increase is not offset by volume loss. A plausible explanation for this phenomenon is that premium brands do not directly compete with the store brand, but instead focus on serving their core quality-conscious consumer segments with the introduction of new product varieties. In contrast, second-tier brands typically retaliate against store brand entry with lower prices and/or increased promotional activity. As price competition intensifies in the lower end of the market, other national brands differentiate themselves by raising prices (and presumably perceived product quality). Specifically, our results suggest that new product introductions at higher prices have a positive impact on manufacturer performance. Even in the particular situation of store brand entry, we find support for the general defensive product strategy recommended by Hauser and Shugan (1983) and Gruca et al. (2001). Investment in product innovations can enhance a brand's competitive advantage and provide a basis for a sustainable price premium over store brands—innovation and judicious pricing are the two important components of a successful manufacturer competitive strategy. Toothbrush brand Colgate offers a prime example of such strategy: Its significantly larger product assortment commands higher wholesale and retail prices in the poststore brand-entry period. We acknowledge, however, that the success of such strategy is not guaranteed: Similar increases in product variety and prices do not stop toothbrush brand Reach's performance decline.

For the *retailer*, we consistently find two *beneficial effects* of store brand entry: (1) *high unit margins on the store brand itself and* (2) *higher unit margins on the national brands*. In the case of decreasing retail prices, wholesale prices decrease even more. In the case of increasing retail prices, wholesale prices increase to a lesser extent, if at all. This increase in unit margins implies that the retailer indeed strengthened its bargaining position vis-à-vis national brand manufacturers. Moreover, these unit margin increases are typically not offset by volume loss for the retailer, as premium national brands maintain their sales level and second price-tier brands lose market share to the store brand. However, *these benefits do not always translate into higher gross category margin*. In fact, we only find a structural increase in retailer margin for the hot breakfast cereal category, which also experiences higher category demand. Our results support the empirical generalization that, despite their bargaining position, retailers have not been able to consistently increase category profitability (Ailawadi 2001). Moreover, any beneficial effects of store brand entry appear to be limited to the product category: We do not find any evidence of a structural boost to store traffic or store revenue.

Consumers do *not see a general price decrease on national brands after store brand entry*. Whereas second-tier brands often, but not always, become cheaper, premium brands become even more expensive. The most consistent consumer benefits are *an enlarged product assortment by both store and national brands and intensified price promotional activity*. While we do not observe all components of social welfare (product quality, manufacturer, and retailer costs), our findings on average price and category demand allow for some speculation. For both hot breakfast cereal and toothbrushes, average price paid is lower and category sales are higher after store brand entry. It appears that some social surplus is created, which benefits the retailer (higher category margin), the premium-tier national brand (higher manufacturer revenues), and the consumers (lower average price and enlarged product assortment). In contrast, the paper towels category experiences an increase in average price paid, while both the paper towels and soap category experience a decrease in category sales in the postentry period. In these categories, store brand entry does not appear to benefit the retailer (lower category margin) and the second-tier national brands (lower revenues for Scott and Ivory). Consumers still enjoy increased product choice, including the low-priced store brand.

Overall, our findings on category demand offer a potential "win-win" scenario for the retailer and premium brand manufacturers and invite national brands to rethink their perception of store brands as detrimental. While store brands and national brands

compete for market share, they may mutually benefit in the stimulation of primary demand in certain categories.

Despite providing a number of interesting insights, our study has several limitations that provide an opportunity for future research. First, we had data only from a single chain—Dominick's. Therefore, we could not study the impact of store brand entry on competition between retailers. Still, the potential for such impact appears limited, as we do not find any effect of store brand entry on store traffic and revenues. It would be valuable to extend our results with data from other retailers in other product categories. Second, other factors beyond store brand entry may influence our estimates in the pre- and postentry periods. As we have established that store brand entry did produce structural change, future research could compare this impact with the effect of other structural changes that may have occurred in the full time period. Third, our focus on pricing actions leaves other marketing variables such as product quality, packaging, and advertising as unexplored topics in the context of store brand entry. In particular, recent research suggests that store brands intentionally imitate the leading national brands, and thus are more likely to compete with the market leader (Sayman et al. 2002, Scott-Morton and Zettelmeyer 2001). Our empirical findings do not contradict this phenomenon, as the market leader happens to be a second-tier brand in each of our categories. Future research could disentangle the price tier versus market leadership explanation. Fourth, we had information on retail prices and retailer unit margins, which allows calculation of average wholesale prices. While the empirical analysis did show evidence of wholesale price adjustment by some manufacturers, change may have occurred in other promotional expenses from manufacturers to the retailer, such as slotting allowances, buy-back charges, failure fees, etc. Fifth, we focused on the typical case of store brand entry in the lower price tiers. Full-scale entry by high price-tier store brands may well lead to different results, and remains an unresolved topic for future research. Finally, our dataset of *four* categories enables exploratory replication, rather than large-scale hypothesis testing to explain the cross-category variation in store brand entry effects. More extensive datasets would allow a test of the theoretical framework on cross-category differences, integrating previous literature on multiple category characteristics affecting consumer response (e.g., Narasimhan et al. 1996), competitive interaction, and store brand success factors (e.g., Raju et al. 1995).

As a general conclusion, store brand entry impacts market players in complex ways. In order to be successful in the market, manufacturers and retailers need to find "win-win" situations with store brand entry. The findings in this paper are important because they show the empirical realization of mutual benefits and because they identify marketing strategies that lead to such win-win situations. Ultimately, the nature of the competitive/cooperative interactions between manufacturers and retailers helps determine success versus failure in today's marketplace.

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References

Abraham, Magid M., Leonard M. Lodish. 1987. Promoter: An automated promotion evaluation system. *Marketing Sci.* **6**(2) 101–123.

Ailawadi, Kusum L. 2001. The retail power-performance conundrum: What have we learned? *J. Retailing* **77**(3) 299–318.

Ailawadi, Kusum L., Bari Harlam. 2002. The effects of store brands on retailer profitability: An empirical analysis. *J. Marketing*. Forthcoming.

Ailawadi, Kusum L., Scott Neslin. 1998. The effect of promotion on consumption: Buying more and consuming it faster. *J. Marketing Res.* **35**(3) 390–398.

Ailawadi, Kusum L., Scott Neslin, Karen Gedenk. 2001. Pursuing the value conscious consumers: Store brands versus national brand promotions. *J. Marketing* **65** 71–89.

Allenby, Greg, Peter Rossi. 1991. There is no aggregation bias: Why macro logit models work. *J. Bus. Econom. Statist.* **9**(1) 1–14.

Andrews, D. W. K. 1993. Test for parameter instability and structural change with unknown change point. *Econometrica* **61** 821–856.

Bell, David R., Jeongwen Chiang, V. Padmanabhan. 1999. The decomposition of promotional response: An empirical generalization. *Marketing Sci.* **18**(4) 504–526.

Blattberg, Robert C., Kenneth J. Wisniewski. 1989. Price-induced patterns of competition. *Marketing Sci.* **8** 291–309.

Bronnenberg, Bart J., Vijay Mahajan, Wilfred Vanhonacker. 2000. The emergence of market structure in new repeat-purchase categories: A dynamic approach and an empirical application. *J. Marketing Res.* **37**(1) 16–31.

Brown, M. B., A. B. Forsythe. 1974. Robust tests for equality of variances. *J. Amer. Statist. Association* **69** 364–367.

Charemza, Wojciech, Derek J. Deadman. 1997. *New Directions in Econometric Practice: General to Specific Modelling, Cointegration and Vector Autoregression*. Edward Elgar, Cheltenham, U.K.

Chevalier, Judith A., Anil K. Kashyap, Peter E. Rossi. 2003. Why don't prices rise during periods of peak demand? Evidence from scanner data. *Amer. Econom. Rev.* Forthcoming.

Chintagunta, Pradeep. 2002. Investigating category pricing behavior in a retail chain. *J. Marketing Res.* **39**(2) 141–154.

Chintagunta, Pradeep K., Andrew Bonfrer, Inseong Song. 2002. Investigating the effects of store brand introduction on retailer demand and pricing behavior. *Management Sci.* **48**(10) 1242–1267.

Christen, Markus, Sachin Gupta, John C. Porter, Richard Staelin, Dick R. Wittink. 1997. Using market-level data to understand promotion effects in a nonlinear model. *J. Marketing Res.* **34**(August) 322–334.

Connor, John M., Everett B. Peterson. 1992. Market-structure determinants of national brand-private label price differences of manufactured food products. *J. Indust. Econom.* **40**(2) 157–171.

Corstjens, Marcel, Rajiv Lal. 2000. Building store loyalty through store brands. *J. Marketing Res.* **37**(3) 281–291.

Dekimpe, Marnik G., Dominique M. Hanssens. 1995. The persistence of marketing effects on sales. *Marketing Sci.* **14**(1) 1–21.

Dekimpe, Marnik G., Dominique M. Hanssens. 1999. Sustained spending and persistent response: A new look at long-term marketing profitability. *J. Marketing Res.* **36** 397–412.

Dekimpe, Marnik G., Dominique M. Hanssens, Jorge Silva-Risso. 1999. Long-run effects of price promotions in scanner markets. *J. Econometrics* **89** 269–291.

Dekimpe, Marnik G., Jan Benedict, E. M. Steenkamp, Martin Mellens, P. Vanden Abeele. 1997. Decline and variability in brand loyalty. *Internat. J. Res. Marketing* **14** 405–420.

Dhar, Sanjay K., Stephen Hoch. 1997. Why store brand penetration varies by retailer. *Marketing Sci.* **16**(3) 208–227.

Dickey, D. A., W. A. Fuller. 1979. Distribution of the estimators for autoregressive time series with a unit root. *Econometrica* **49** 1057–1072.

Enders, Walter. 1995. *Applied Econometric Time Series.* Wiley, New York.

Evans, Lewis, Graeme Wells. 1983. An alternative approach to simulating VAR models. *Econom. Lett.* **12**(1) 23–29.

Gregory, A. W., B. E. Hansen. 1996a. Residual-based tests for cointegration in models with regime shifts. *J. Econometrics* **70** 99–126.

Gregory, A. W., B. E. Hansen. 1996b. Tests for cointegration in models with regime and trend shifts. *Oxford Bull. Econom. Statist.* **58** 555–560.

Gruca, Thomas S., D. Sudharshan, K. Ravi Kumar. 2001. Marketing mix response to entry in segmented markets. *Internat. J. Res. Marketing* **18**(1–2) 53–56.

Hamilton, James. 1994. *Time Series Analysis*. Princeton University Press, Princeton, NJ.

Hauser, John R., Steven M. Shugan. 1983. Defensive marketing strategies. *Marketing Sci.* **2**(4) 319–360.

Hoch, Stephen J. 1996. How should national brands think about private labels? *Sloan Management Rev.* **37**(Winter) 89–102.

Hoch, Stephen J., S. Banerji. 1993. When do private labels succeed? *Sloan Management Rev.* **34**(Summer) 57–68.

Hoch, Stephen J., Leonard M. Lodish. 2003. Store brands and category management. *J. Retailing*. Forthcoming.

Hoch, Stephen J., Byung-do Kim, Alan L. Montgomery, Peter E. Rossi. 1995. Determinants of store-level price elasticity. *J. Marketing Res.* **32**(1) 17–29.

Horváth, Csilla, Jaap E. Wierenga. 2002. Combining time series and cross sectional data for the analysis of dynamic marketing systems. Working paper, University of Groningen, Groningen, The Netherlands.

Huber, Joel, Morris B. Holbrook, Barbara Kahn. 1986. The effect of context and of additional information on price sensitivity. *J. Marketing Res.* **23**(August) 250–260.

Jedidi, Kamel, Carl F. Mela, Sunil Gupta. 1999. Managing advertising and promotion for long-run profitability. *Marketing Sci.* **18**(1) 1–22.

Johansen, Søren, K. Juselius. 1990. Maximum likelihood estimation and inference on cointegration with applications to the demand for money. *Oxford Bull. Econom. Statist.* **52**(2) 169–210.

Johansen, Søren, Rocco Mosconi, Bent Nielsen. 2000. Cointegration analysis in the presence of structural breaks in the deterministic trend. *Econometrics J.* **3** 216–249.

Kadiyali, Vrinda, Pradeep Chintagunta, Naufel Vilcassim. 2000. An empirical investigation of pricing in a local market. *Marketing Sci.* **19**(2) 127–148.

Kornelis, Marcel, Peter S. H. Leeflang, Marnik Dekimpe. 2001. Modeling market shake-ups caused by new entrants. Working paper, University of Groningen, Groningen, The Netherlands.

Kurt Salmon Associates. 1998. A glance at an upbeat future. *Supermarket Bus.* Private Label Supplement **53**(10) 9–10.

Lal, Rajiv. 1990. Manufacturer trade deals and retail price promotions. *J. Marketing Res.* **27**(4) 428–444.

Lee, Eunkyu, Richard Staelin. 2000. A general theory of demand in a multi-product multi-outlet market. Working paper, http://faculty.fuqua.duke.edu/%7Erstaelin/bio/gentheory.pdf.

Lieberman, Marvin, David Montgomery. 1988. First-mover advantages. *Strategic Management J.* **9**(Summer) 41–58.

Lütkepohl, Helmut. 1993. *Introduction to Multiple Time Series Analysis*, 2nd ed. Springer-Verlag, Berlin, Germany.

Maddala, G. S., In-Moo Kim. 1998. *Unit Roots, Cointegration, and Structural Change*. Cambridge University Press, Cambridge, U.K.

Mason, Charlotte H. 1990. New product entries and product class demand. *Marketing Sci.* **9**(1) 58–73.

Mela, Carl F., Sunil Gupta, Donald R. Lehmann. 1997. The long-term impact of promotion and advertising on consumer brand choice. *J. Marketing Res.* **34**(2) 248–261.

Mills, David E. 1995. Why retailers sell private labels. *J. Econom. Management Strategy* **4**(3) 509–528.

Narasimhan, Chakravarthi, Neslin, Scott A., Subrata K. Sen. 1996. Promotional elasticities and category characteristics. *J. Marketing* **60**(2) 17–30.

Narasimhan, Chakravarthi, Ronald T. Wilcox. 1998. Private labels and the channel relationship: A cross-category analysis. *J. Bus.* **71**(4) 573–600.

Nijs, Vincent, Marnik Dekimpe, Jan-Benedict Steenkamp, Dominique M. Hanssens. 2001. The category demand effects of price promotions. *Marketing Sci.* **20**(1) 1–22.

Pauwels, Koen, Dominique M. Hanssens, S. Siddarth. 2002. The long-term effects of price promotions on category incidence, brand choice and purchase quantity. *J. Marketing Res.* **34**(November) 421–439.

Perron, Pierre. 1989. The great crash, the oil price shock and the unit root hypothesis. *Econometrica* **57**(6) 1361–1401.

Perron, Pierre. 1990. Testing for a unit root in a time series with a changing mean. *J. Bus. Econom. Statist.* **8**(2) 153–162.

Pesaran, M. Hashem, Hossein, Samiei. 1992. An analysis of the determination of Deutsche Mark/French Franc exchange rate in a discrete-time target-zone model. *Econom. J.* **102**(411) 388–401.

Pesaran, M. Hashem, Ron P. Smith. 1998. Structural analysis of cointegrating VARs. *J. Econom. Surveys* **12** 471–506.

Phillips, Peter C. B., Pierre Perron. 1988. Testing for a unit root in time series regression. *Biometrika* **75** 335–346.

Powers, Keiko, Dominique Hanssens, Hser Yih-ing, Anglin M. Douglas. 1991. Measuring the long-term effects of public policy: The case of narcotics use and property crime. *Management Sci.* **37**(6) 627–644.

Quelch, John A., David Harding. 1996. Brand versus private labels: Fighting to win. *Harvard Bus. Rev.* **74**(1) 99–109.

Raju, Jagmohan. 1992. The effect of price promotions on variability in product category sales. *Marketing Sci.* **11**(Summer) 207–220.

Raju, Jagmohan S., Raj Sethuraman, Sanjay Dhar. 1995. The introduction and performance of store brands. *Management Sci.* **41**(June) 957–978.

Sayman, Serdar, Raju Jagmohan, Stephen Hoch. 2002. The strategic positioning of store brands. *Marketing Sci.* **21**(4) 378–397.

Scott-Morton, Fiona, Florian Zettelmeyer. 2001. The strategic positioning of store brands in retailer-manufacturer negotiations. Working paper, http://faculty.haas.berkeley.edu/florian/.

Sethuraman, Raj, V. Srinivasan, Doyle Kim. 1999. Asymmetric and neighborhood cross-price effects: Some empirical generalizations. *Marketing Sci.* **18**(1) 23–41.

Srinivasan, Shuba, Koen Pauwels, Dominique M. Hanssens, Marnik Dekimpe. 2001. Do promotions benefit manufacturers, retailers or both? *Marketing Science Institute*, Report no. 01-120.

Srinivasan, Shuba, Peter Popkowski Leszczyc, Frank M. Bass. 2000. Market share response and competitive interaction: The impact of temporary, evolving and structural changes in prices. *Internat. J. Res. Marketing* **17**(4) 281–305.

Steenkamp, Jan-Benedict E. M., Marnik G. Dekimpe. 1997. The power of store brands: Intrinsic loyalty and conquesting power. *Long Range Planning* **30**(6) 917–930.

Tyagi, Rajeev, Jagmohan S. Raju. 2001. The effect of entrant's brand ownership on national brand positioning strategies. Working paper, Graduate school of Management, University of California, Irvine, CA.

Van Heerde, H. J., P. S. H. Leeflang, Dick R. Wittink. 2000. The estimation of pre- and post-promotion dips with store-level scanner data. *J. Marketing Res.* **37**(3) 383–395.

Walters, Rockney G., Scott B. MacKenzie. 1988. A structural equations analysis of the impact of price promotions on store performance. *J. Marketing Res.* **25**(February) 51–63.

Walters, Rockney G., Heikki Rinne. 1986. An empirical investigation into the impact of price promotions on retail store performance. *J. Retailing* **62**(3) 237–266.

Wolters, J., T. Terasvirta, H. Lutkepohl. 1998. Modeling the demand for M3 in the unified Germany. *Rev. Econom. Statist.* **80**(3) 399–409.

Zivot, Eric, Donald W. K. Andrews. 1992. Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *J. Bus. Econom. Statist.* **10**(3) 251–270.

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