DEPARTEMENT TOEGEPASTE ECONOMISCHE WETENSCHAPPEN

ONDERZOEKSRAPPORT NR 9606

Erosion and Variability in Brand Loyalty

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D/1996/2376/6

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The authors are indebted to GfK Foodscan for providing the data used in this study, and to the Belgium National Science Foundation (N.F.W.O.) for financial support under grant No. 2.0062.94.

EROSION AND VARIABILITY IN BRAND LOYALTY

Abstract

In this paper, we examine the over-time behavior of brand loyalty for a large set of brands drawn from many product categories. Using the brand-loyalty operationalization of Colombo and Morrison (1989), the following conclusions are obtained. First, little support is found for the often-heard contention that brand loyalty is gradually declining over time. Second, while the short-run variability around a brand's mean loyalty level is not negligible, no evidence is found that this variability has systematically increased over time, and it can be reduced considerably through a simple smoothing procedure. Finally, the brand-loyalty pattern for market-share leaders is found to be more stable than for other brands.

1. INTRODUCTION

A critical issue for the continued success of a firm is its capability to retain its current customers and make them loyal to its brands. Indeed, the costs of attracting a new customer have been found to be about six times higher than the costs of retaining old ones (Rosenberg and Czepiel 1993), loyal customers are typically less price sensitive (Krishnamurthi and Raj 1991), and the presence of a loyal customer base provides the firm with valuable time to respond to competitive actions (Aaker 1991). A large number of loyal customers is a competitive asset for a brand, and has been identified as a major determinant of its equity.

Managers are therefore worried about recurring claims in the popular press that the brand loyalty of many national brands is gradually eroding. Brand loyalty is often said to be replaced by price loyalty (see e.g. *Discount Merchandiser* 1993), while also the increasing fragmentation of the market (*Marketing* 1993), the growing popularity of cheaper regional and private-label brands (*Brandweek* 1993), and an overall recession (*Financial World* 1993) have been cited as reasons for an apparent decrease in brand loyalty in recent years. Moreover, this pattern is expected to continue in the future, both in the United States (*Beverage World* 1993) and Europe (*Marketing* 1993). Pfouts (1994) calls the diminishing brand loyalty on the part of the consumer, especially in food items, one the most striking revolutions in recent years, and a recent article in *Industry Week* (1993) even claims that brand loyalty is "a thing of the past".

Still, the empirical evidence in the academic literature is equivocal. Several authors (see e.g. Dodson et al. 1978 and Strang 1975) have argued that the growing reliance of many national brands on price promotions will be harmful to their long-term health, and East and Hammond (1995) and Ehrenberg (1988) find that the percentage of buyers who repeat purchase in a given time period steadily falls over time. Johnson (1984), on the other hand, calls the overall decline in brand loyalty a myth, and neither Ehrenberg, Hammond and Goodhardt (1994) nor Lal and Padmanabhan (1995) have found any evidence of negative long-run consequences of price promotions (see also Blattberg et al. 1995 for a more detailed literature review).

In line with recent calls for empirical generalizations in marketing as a means to advance marketing knowledge (see e.g. Bass and Wind 1995), we contribute to this debate by conducting a large-scale study in which we analyze the over-time evolution of brand loyalty for many (92)

brands in multiple (21) frequently-purchased product categories.

When studying the over-time behavior of brand loyalty, attention should not be limited to the presence/absence of a systematic or long-run increase or decrease in its level. Equally important is the extent of variability around the brand's mean loyalty level, or around this observed long-run trend. Conceptually, large fluctuations would cast doubt on the managerial and scientific usefulness of the brand-loyalty concept, since one of its underlying principles is a substantial degree of consistency over an extended period of time (Jacoby and Chestnut 1978). Moreover, large fluctuations in brand loyalty would question the validity of the findings in earlier studies (e.g. Bultez 1990a,b; Kannan and Sanchez 1994) which have provided a one-shot description of a particular market. In this study, we quantify the extent of variability in brand loyalty for a wide variety of brands and product categories, and assess whether this variability has increased over time. Indeed, a growing reliance on price promotions may not only have affected the intrinsic health of the brand (as reflected in the size of its loyal customer base), but may also have resulted in increasing fluctuations around that level. To the best of our knowledge, we are the first to empirically assess this aspect of the dynamic behavior of brand-loyalty measures.

To summarize, the purpose of this study is to examine both the over-time evolution of brand loyalty and the fluctuations in brand loyalty around the trend (if any) for a large set of brands drawn from many product categories. To illustrate our research issues, some scenarios are presented graphically in Figure 1. We give consecutive empirical loyalty estimates for a brand of condensed milk, light beer and regular beer, respectively. The brand-loyalty estimates are derived from the Colombo and Morrison (1989) model (see Section 2.1), which was applied to household purchase data as described in Section 3. In panel 1A, there is no evidence of erosion, and also the variability around the mean loyalty level is very limited. This gives the manager a clear and unambiguous indication on the magnitude of the loyalty commanded by this brand. In Panel 1B, on the other hand, the fluctuations around the mean level seem to have become more pronounced over time, making it harder to draw inferences about the brand's intrinsic strength. In panel 1C, there is clear evidence of loyalty erosion. The latter two scenarios are unfavorable, and the observed loyalty patterns provide management with a clear warning signal which may warrant managerial action. The graphs in Figure 1 are just illustrative

examples of some scenarios, and the empirical analyses in Section 4 are meant to formalize the discussion on their relative occurrence.

Insert Figure 1 about here

The remainder of the paper is organized as follows. Section 2 outlines the research methodology used to address our two main research questions. Section 3 describes the data set, and empirical results are presented in Section 4. Section 5 concludes with some managerial implications and areas for future research.

2. MODEL DEVELOPMENT

2.1. The Colombo and Morrison model

Central to our analysis is the model of Colombo and Morrison (1989), which is applied to successive switching matrices to create a time series of brand-loyalty estimates. The Colombo and Morrison (C&M) model uses a behavioral measure of brand loyalty, and was selected as (1) it is well established in the marketing literature (see e.g. Bayus 1992; Bordley 1989; Bultez 1990a,b; Kannan and Sanchez 1994 for other applications), (2) its parameter estimates have clear managerial interpretations, and (3) the data requirements are few.

The input to the model is a switching matrix whose elements (i,j) represent the proportion of consumers that bought brand i on one purchase occasion but switched to brand j on the next occasion. The element (i,j) therefore gives the conditional probability that brand j is purchased, given that i was bought the previous time. The key underlying assumption of the model is that there are two kinds of consumers:

- people who are *intrinsically loyal*, and stay with the same brand, and
- *potential switchers*, who on every purchase occasion choose between brands according to a zero-order process.

All potential switchers are assumed to have the same probability to buy a specific brand, but this probability may differ across brands. The proportion of loyal buyers and the potential switchers' choice probabilities are linked to the elements of the observed switching matrix through:

$$
\begin{aligned}
p_{ii} &= \alpha_i + (1 - \alpha_i)\ \pi_i\ , \\
p_{ij} &= (1 - \alpha_i)\ \pi_j \qquad\qquad i \neq j
\end{aligned}
\tag{1}
$$

where p_{ij} is an element of the switching matrix, π_i the proportion of potential switchers buying brand *i*, and α_i the proportion of the current buyers of brand *i* which is intrinsically loyal. The first equation states that the (conditional) probability to repurchase brand *i* depends on (1) the proportion of loyals (α_i), and (2) the proportion (π_i) of the potential switchers [$(1-\alpha_i)$] who decided to re-purchase brand *i* after all. The second equation shows how the conditional probability p_{ij} equals the proportion (π_j) of the potential switchers [$(1-\alpha_i)$] which chooses brand *j*. Clearly, every actual switcher is a potential switcher, but not every repeat purchase comes from a loyal customer.

The π_i parameters also have a clear managerial interpretation, viz., the respective brands' conquesting power with respect to the potential switchers. However, in line with the topic of the special issue, attention in this study will be focused on the α_i-estimates, which indicate the proportion of *loyals* of brand *i*. We refer the interested reader to the original Colombo and Morrison article for a more detailed discussion of both the model and its estimation.

2.2. Analysis of loyalty erosion

The application of the C&M-model to successive switching matrices results in a time-series of α_i-parameters, whose over-time evolution is assessed using both deterministic- and stochastic-trend analyses. In the deterministic analyses, we check whether there is a systematic and continuing decrease (increase) in brand loyalty over time. In the stochastic-trend analyses, attention is focused on whether all observed deviations are just temporary deviations from a fixed mean level. If this is the case, any observed drop in loyalty is only of a temporary nature, and does not initiate a persistent or continuing decrease in brand loyalty. While there is considerable debate in the economics literature on the relative merits of both approaches (see e.g. Diebold and Nerlove 1990), we will treat both analyses as *complementary* ways to study the relative incidence of loyalty erosion.

2.2.1. Deterministic-trend analysis

The presence of deterministic trends is tested using a linear regression model with the α_i as dependent and time as independent variable.[1] All analyses are performed at three levels of aggregation. At the highest level of aggregation, we pool all α_i-vectors, but allow for brand-specific and category-specific differences in the intercept, i.e.

$$\alpha_{i,t} = b_0 + b_1 T_t + \sum_{k=2}^{K} \delta_k BRAND_K + \sum_{p=2}^{P} \gamma_p CAT_p + u_{i,t} , \qquad (2)$$

where $\alpha_{i,t}$ is the brand-loyalty estimate of brand i derived from its t-th switching matrix, T_t the corresponding value of a deterministic-trend variable, $BRAND_k$ (k=2, ..., K) and CAT_p (p=2, ..., P) are brand and category-specific dummy variables, $u_{i,t}$ is an error term, and b_0, b_1, δ_k and γ_p are parameters which have to be estimated. A significantly negative coefficient b_1 would confirm an overall erosion of brand loyalty in the market.

Second, to allow for different levels of erosion across product categories (e.g. because of differing levels of competition or because of differences in the overall level of promotional expenditures), deterministic-trend regressions were estimated at the category level:

$$\alpha_{i,t}^{(p)} = b_{0,p} + b_{1,p} T_t + \sum_{k=2}^{K_p} \delta_{k,p} BRAND_{k,p} + u_{i,t}^{(p)} , \qquad (3)$$

where K_p gives the number of brands in product category p (p = 1, ...,P), and where the superscript *(p)* is added to indicate that we now pool observations within a given product category. As indicated in Section 3, data were available for 21 product categories, and equation (3) was applied separately to each product category.

Finally, we assessed the presence of deterministic trends at the individual-brand level:

$$\alpha_{i,t} = b_{0,i} + b_{1,i} T_t + u_{i,t} . \qquad (4)$$

Ninety-two such analyses (see Section 3.3. and 3.4) were carried out. A significantly negative coefficient $b_{1,p}$ [$b_{1,i}$] in equation (3) [equation 4] would indicate loyalty erosion for product category p [brand i].

2.2.2. Stochastic-trend analysis

Deterministic-trend analysis is but one approach to quantify long-run evolutions. Following Dekimpe and Hanssens (1995a,b), we also assess whether a stochastic trend is present in a given sequence of loyalty estimates. This allows us to determine whether the observed fluctuations are just temporary deviations from a fixed (mean) level, or whether they initiate a new trend without any reversion to previous levels.

This distinction can be clarified through the following first-order process describing the over-time behavior of brand i's loyalty estimates:

$$(1 - \phi_i L)\ \alpha_{i,t} = c_i + u_{i,t}\ , \tag{5}$$

where ϕ_i is an autoregressive parameter, L the lag operator (i.e. $L\ \alpha_{i,t} = \alpha_{i,t-1}$), $u_{i,t}$ a series of zero mean, constant-variance and uncorrelated shocks, and c_i a constant. Applying successive backward substitutions allows us to write equation (5) as

$$\alpha_{i,t} = [c_i / (1 - \phi_i)] + u_{i,t} + \phi_i\ u_{i,t-1} + \phi_i^2\ u_{i,t-2} + \ldots \tag{6}$$

Clearly, when $\phi_i < 1$, the impact of past shocks diminishes and eventually becomes zero, i.e. any shock (which may, for example, be caused by an increase in promotional support) then causes only a temporary deviation from the series' mean level $c_i/(1-\phi_i)$, and therefore does not initiate a continuing erosion or increase. On the other hand, when $\phi_i = 1$, past effects do not diminish and the loyalty estimates do not revert to any historically observed level. Instead, the series evolves freely in one direction or another, and a stochastic trend is said to be present. Following Dekimpe and Hanssens, the Augmented Dickey-Fuller (1979) test is used to empirically determine whether ϕ_i equals one (i.e. whether there is a unit root in the autoregressive polynomial of equation 5). The test equation used is

$$\Delta\alpha_{i,t} = a_{0,i} + b_i\ \alpha_{i,t-1} + a_1\ \Delta\alpha_{i,t-1} + \ldots + a_m\ \Delta\alpha_{i,t-m} + u_{i,t}\ , \tag{7}$$

where the m $\Delta\alpha_{i,t-j}$ are added to ensure that $u_{i,t}$ is white noise. The t-statistic of b is compared with the critical values in Fuller (1976), and the unit-root null hypothesis is rejected if the obtained value is smaller than the critical value. Tests for stochastic trends will only be

performed at the individual brand level (the strict temporal ordering in the test equation cannot handle pooled data), and will only be implemented for the longer time series because of power considerations (see Sections 3 and 4 for details).

2.3. How variable are the brand-loyalty estimates?

When analyzing the amount of short-run variability in the loyalty estimates, we distinguish two scenarios: brands exhibiting a trend in brand loyalty as indicated by the deterministic trend regressions in equation (4), and brands that showed no trend in brand loyalty. Due to statistical considerations (the population mean and variance of trending series are not defined, making the interpretation of their sample counterparts debatable), we treat both situations somewhat differently.

For the "*non-trending*" brands, we compute the sample standard deviation in their over-time loyalty estimates to get insight in their absolute amount of variability. This measure of within-brand variability will be calculated for each of the non-trending brands, and summary statistics will be presented. Second, we consider whether the short-run variability has changed over time. To that extent, we calculate whether the absolute deviations from a brand's mean loyalty level have systematically increased (or decreased) over time. This test is based on the following equation:

$$|\alpha_{i,t} - \overline{\alpha_i}| = b_{0,i} + b_{1,i} T_t + u_{i,t} , \qquad (8)$$

where $\overline{\alpha_i}$ is the sample mean of the series, and where $b_{1,i}$ reflects the change in variability over time.

For the "*trending*" brands, we compute the standard deviation of the residuals in equation (4) as a measure of the absolute amount of variability.[2] Similarly, we test whether the variability has increased over time by replacing the absolute deviation in equation (8) by the absolute deviations from the trend line identified in equation (4).

3. DATA DESCRIPTION

Panel data describing the purchase histories in 1993-1994 of approximately 4,000 Dutch households in 21 different product categories were provided by GfK Foodscan. All product

categories were frequently purchased grocery products, covering a variety of food/beverage (e.g. margarine, beer), personal-hygiene (e.g. sanitary towels) and pet-food (e.g. dry and wet cat food) products (see Table 1). Within a product category, all brands with an average market share of more than four percent were retained. The number of brands satisfying this minimum-share requirement varied across product categories, and ranged from two (frying margarine) to seven (regular beer), but the combined market share of the included brands exceeded 50 percent in all instances. In total, 92 brands were extracted from the data set. Moreover, for every product class we added an others-category to the switching matrix to accommodate purchases of the smaller brands.

Insert Table 1 about here

The length of the available time span was either one or two years, which is comparable to the sample length in the erosion studies of East and Hammond (1995) and Ehrenberg et al. (1994), and to the scanner-data study of Lal and Padmanabhan (1995) on the negative long-run impact of price promotions. Depending on the mean interpurchase time in the product category, monthly or bimonthly switching matrices were constructed.[3] This resulted in, respectively, 23, 11 or 5 switching matrices and corresponding loyalty estimates per brand.[4] Following Rao and Sabavala (1981), Carpenter and Lehmann (1985) and Grover and Srinivasan (1987), we used all purchases a household made in given (bi)monthly interval. We only deleted purchases when multiple purchases in the same category were made on the same day, as it was impossible to empirically determine the purchase order in those instances (see Carpenter and Lehmann 1985 and Shoemaker and Shoaf 1977 for a similar practice). To accommodate people who did not purchase any brand in a product category within the considered (bi)monthly interval, a null-category was introduced (Chiang 1991, Colombo and Morrison 1989). The size of the switching matrix in product category p is therefore N_p+2, with N_p the number of brands satisfying the minimum-share requirement in that category, and the two extra columns (rows) reflecting, respectively, the others-brands and the null-category. However, only the N_p α-estimates corresponding to "real" brands are used in subsequent analyses.

4. EMPIRICAL FINDINGS

4.1. Has brand loyalty eroded over time?

Results for the pooled model in equation (2) are given in Table 2. Differences in the sampling interval (monthly or bimonthly) were accommodated by giving the trend variable in the latter case the mean value of the corresponding monthly values (i.e. 1.5, 3.5, ...).

Insert Table 2 about here

To account for differences in both the sampling interval and the length of the considered time span (one or two years), both weighted and unweighted estimation procedures were used. Weighted least squares was applied to prevent that product categories for which more data points were available would completely drive the results. Three weighing schemes were adopted. In the first scheme, the weight is proportional to the length of the sampling interval (monthly = 1; bimonthly = 2). Second, to account for differences in the number of years for which we have data (one or two year), we assigned a weight proportional to the inverse of the sampling length. Finally, a combination of the two was used according to the following scheme: monthly-1 year =2; bimonthly-1 year = 2; bimonthly-one year = 4; monthly-2 years = 1. In none of these instances was the slope of the trend variable significant. Thus, no evidence is found of an overall erosion in brand loyalty.

Results at the product-category and brand level are presented in Table 3. Again, little evidence of loyalty erosion is found. We observed a significant trend for only three (low-fat margarine, frying margarine, and panty liners) of the 21 product categories considered. Moreover, one of these three trend coefficients (for the low-fat margarine market) was positive, and the two other categories experienced a major new-product introduction. After controlling for this event in equation (3) through a step dummy variable, the trend in both markets became insignificant.

Insert Table 3 about here

A similar picture emerged at the individual-brand level. A significant trend was found in only 11 instances, of which only eight were negative. Moreover, two of these eight brands belonged

to one of the aforementioned categories which experienced a new product introduction, and their trend coefficient became insignificant after controlling for this event. This suggests that their "apparent" erosion was caused by a major structural break in the market, and therefore should not be interpreted as evidence of a gradual erosion because of an increased use of promotional spending.

A logit model was estimated to examine whether the finding that a brand was "trending" (=1) or "non-trending" (=0) was systematically related to (1) market leadership (in terms of market share) in the product category, (2) relative price of the brand, (3) level of market concentration, and (4) median interpurchase time in the product category. None of these covariates were found to have a significant effect. In contrast, East and Hammond (1996) report a negative relationship between erosion and market-share leadership, and a positive relationship between erosion and market concentration. The latter result, which according to East and Hammond was unexpected, is not confirmed in our analyses, nor did we find a systematic relationship with a variable not explicitly considered in East and Hammond (1996): the brand's relative price.

The unit-root tests confirmed the absence of a systematic erosion. Equation (7) was applied to the 14 brands for which 23 observations were available.[5] In only two instances did we find evidence of a stochastic trend. One of them was a frying-margarine brand, and after controlling for the new-product introduction in that category using the structural-break procedure advocated in Perron and Vogelsang (1992), the unit-root null hypothesis was rejected.

4.2. Variability in the brand-loyalty estimates

For each of the 83 "non-trending" brands, we computed the standard deviation in their successive loyalty estimates.[6] Summary statistics for these 83 brands are given in the left-hand column of Table 4. For the 9 "trending" brands, the square root of the residual variance of a deterministic-trend regression was derived, and the corresponding summary statistics are given in the right-hand column of Table 4. Even though an average (median) standard deviation of 0.06 (0.05) is not excessive, the short-run variability around the series' mean or trend is *not* negligible either.

Insert Table 4 about here

A linear regression model was subsequently estimated to determine whether the extent of variability was systematically related to (1) market-share leadership, (2) the brand's relative price, (3) the level of market concentration in the product category, (4) the length of the sample (1 or 2 years), and (5) the length of the sampling interval (monthly or bi-monthly). Market leaders experienced a significantly ($p<0.05$) smaller amount of variability in their brand-loyalty estimates, but none of the remaining effects was significant.

To reduce the amount of short-run variability, a moving average of three consecutive point estimates was constructed. Similar summary statistics as in Table 4 were derived, and presented in Table 5. The short-run variability, as expressed in the series' standard deviation, has been reduced by more than 50% through this simple smoothing operation, and now has a median value of 0.02. Our results therefore suggest that some caution should be exerted with studies which only provide a single snap-shot of the market.

Insert Table 5 about here

Finally, little evidence was found that the variability has systematically changed over time. Indeed, the absolute deviation from their mean loyalty level has only increased (decreased) significantly for 3 (2) of the 83 considered brands. For those 9 brands where the brand-loyalty level showed a significant trend (Section 4.1), no evidence was found that the absolute deviations from that trend level have increased or decreased over time. Using a logit model, no systematic relationship could be detected between the presence/absence of a trend in variability and the brand's market-share leadership or relative price, nor with the median interpurchase time or market concentration in the product category.

5. CONCLUSIONS - AREAS FOR FUTURE RESEARCH

The main findings of our research are encouraging to brand managers and marketing researchers alike:

- we find little support for the often-heard contention that brand loyalty continues to erode;
- even though the short-run variability around a brand's underlying loyalty level is not negligible, it has not increased systematically over time;
- brand loyalty is more stable for market leaders than for others; and
- after a simple smoothing operation, the amount of short-run variability can be reduced considerably.

Our first result supports Johnson's (1984) contention that erosion of brand loyalty may be more of a buzz-word than a well-founded empirical fact. However, it does not concur with East and Hammond's (1996) conclusion that loyalty, in their study measured as the percentage of buyers who repeat-purchase in a given period, systematically declines. This discrepancy with East and Hammond's conclusion seems to confirm Lal and Padmanabhan's contention that two segments of inert consumers exist: a "loyal" segment of consumers with low switching probability and another segment which is more prone to switching on the basis of price (1995, p. 106). East and Hammond operationalized brand loyalty as the percentage of all purchasers who repeat-purchase in a given time period, while the C&M method employed by us distinguishes between loyal buyers and potential switchers, both of whom can be repeat purchasers. East and Hammond's findings may therefore also reflect the intensifying promotional battle for share in the switching-prone segment.

A number of avenues for future research remain open. First, the study of multiple brands and product categories allowed us to draw some empirical generalizations on the dynamic behavior of brand-loyalty measures for frequently-purchased product categories. To further enhance our understanding of the loyalty phenomenon, these findings should be replicated under different conditions (Barwise 1995, Uncles et al. 1994), such as other countries, another time span, or other product categories. Second, even though the length of our sample is comparable to the one used in previous studies on the erosion of brand-loyalty measures, it may be useful to address the erosion debate using longer time spans as well. Combined with moving-window

techniques, this could provide insights on the length of periods of relative stability and erosion. Third, one could also study the flip-side of the brand-loyalty issue, i.e. the evolution and variability in the brands' conquesting power, which is expressed in the π_i estimates of the C&M model. Finally, attention in this study has focused on the over-time variability *within* a given brand's loyalty. More research is also needed on what causes differences in brand loyalty *between* brands, and on the relative contribution of product-, category- and consumer-specific characteristics in explaining these differences.

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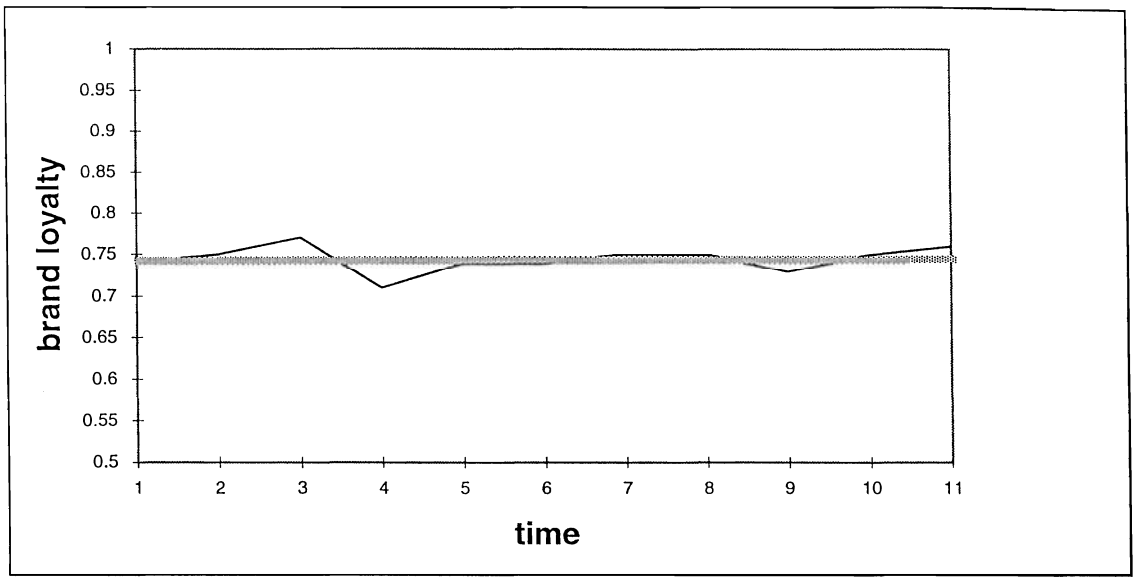
Strang, R.A. 1975. The relationship between advertising and promotion in brand strategy. Cambridge MA: Marketing Science Institute.

Uncles, M.D., Hammond, K., A.S.C. Ehrenberg and R.E. Davis, 1994. A replication study of two brand-loyalty measures. *European Journal of Operational Research* 76 (2), 375-383.

(a)



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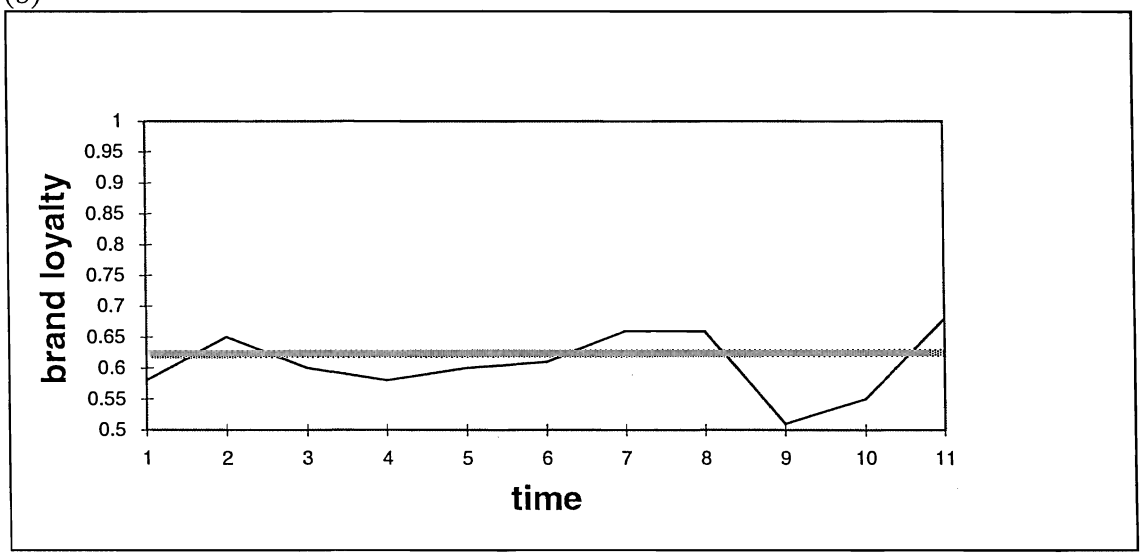

(c)

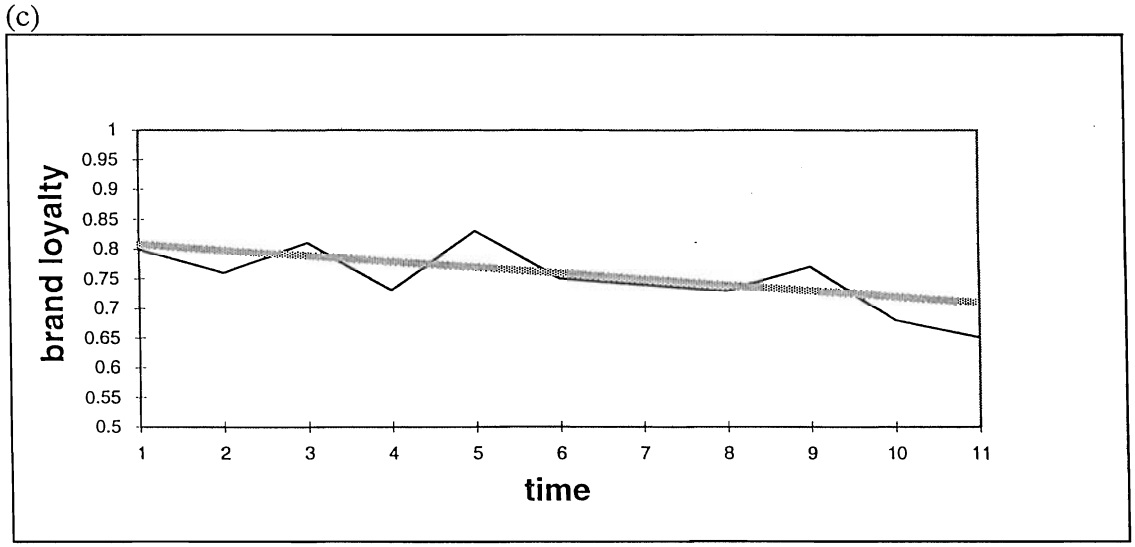

Fig. 1. Loyalty estimates for a major brand of (a) condensed milk, (b) light beer, and (c) regular beer at 11 consecutive points in time.

Table 1
Data description

Product category	Time span (years)	Median inter-purchase time (days)	(Bi)Monthly switching matrices	# Loyalty estimates per brand	# Brands satisfying share requirement	Total market share included brands	Concentration[1]
Food/beverage							
Low-fat margarine	2	19	m	23	6	72	55
Regular margarine	2	16	m	23	6	73	55
Frying margarine	2	19	m	23	2	79	81
Light beer	2	34	b	11	3	96	96
Regular beer	2	23	b	11	7	83	60
Cola	1	15	m	11	3	79	79
Water	1	21	b	5	3	73	73
Green peas	1	31	b	5	4	55	48
Apple sauce	1	24	b	5	4	57	46
Cereals	1	26	b	5	4	86	82
Muesli	1	26	b	5	6	68	55
Decaffeinated coffee	1	21	b	5	3	78	78
Regular coffee	1	18	m	11	4	83	74
Chocolate sprinkles	1	33	b	5	5	55	45
Orange juice	1	24	b	5	5	66	58
Condensed milk	1	16	m	11	5	60	51
Crackers	1	23	b	5	3	70	70
Personal hygiene							
Sanitary towels	2	31	b	11	3	83	83
Panty liners	2	37	b	11	4	80	74
Pet food							
Cat food (dry)	1	19	m	11	6	69	47
Cat food (wet)	1	10	m	11	6	82	61

[1] The concentration of a product category is defined as the total market share of the three largest brands (see e.g. Clarkson and Miller 1982).

Table 2
Erosion of brand loyalty at the aggregate level: Results of the pooled model.

	Trend coefficient (x 10^{-3}) (Standard Error (x 10^{-3}))	Significant trend (5 % level)
Unweighted	-0.05 (0.4)	No
Weighted		
Weight=sampling interval	-0.4 (0.4)	No
Weight=1/sampling length	-0.4 (0.4)	No
Weight= 2*(sampling interval/sampling length)	-0.6 (0.4)	No

Table 3
Erosion of brand loyalty: Results at the product-category and brand level.

	Insignificant regressions (5 % level)	Significant regressions (5 % level)
Number of product categories	18	3 (1 +; 2-)
Number of brands	81	11 (3+; 8 -)

Table 4
Over-time variability in brand loyalty: Summary statistics.

	Standard deviation of the residuals of a regression on:	
	a fixed mean [1]	a linear trend
Number of brands	83	9
Mean	0.06	0.03
Median	0.05	0.02
Standard deviation	0.02	0.02

[1] If the brands belong to a product category with a new-brand introduction, a step-dummy variable was added to the equation.

Table 5
Over-time variability based on a moving average of three consecutive estimates: Summary statistics.

	Standard deviation of the residuals of a regression on:	
	a fixed mean [1]	a linear trend
Number of brands	83	9
Mean	0.02	0.01
Median	0.02	0.008
Standard deviation	0.01	0.01

[1] If the brands belong to a product category with a new-brand introduction, a step-dummy variable was added to the equation.