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Effect of Sales on Brand Loyalty

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1. Introduction

Many theoretical models of sales (e.g., Varian, 1980; Narasimhan, 1988; Lal, 1990) and theoretical and empirical work on firm's strategic pricing and advertising behavior (e.g., Agrawal, 1996; Villas-Boas, 1995) assume that a critical mass of consumers have an intrinsic loyalty to a brand, so that they buy only that brand over time.¹ However, our empirical evidence of switching behavior by orange juice consumers shows that firms' pricing behavior affects whether orange juice consumers switch and that few consumers are actually loyal to one brand.² Moreover, we find that switching is more complex than generally assumed in these theoretical models: Consumers switch between two types of products: frozen and refrigerated orange juice.

Some theoretical models also require that firms be able to identify loyal customers. An extensive marketing literature concentrates on identifying loyal customers (Jacoby and Chestnut, 1978; Grover and Srinivasan, 1987; Colombo and Morrison, 1989). Among the many explanations for brand loyalty, marketing researchers have identified customer inertia, decision biases, uncertainty in the quality of other brands, or other issues. As many of these characteristics cannot be observed, we try to predict switching behavior using only observable household demographic and the frequency with which stores conduct sales: temporary reductions in price from the usual or modal price. We examine switching behavior for the two best-selling types of orange juice products: refrigerated and frozen orange juice.³ We chose orange juice because we were interested in whether switching depended on the ability to store goods bought on sale, which is possible with frozen but not refrigerated juice.

¹ Similarly, in many other models, search costs are assumed to vary across consumers, making the high-search-cost consumers "loyal" (e.g., Salop and Stiglitz, 1977), or switching costs vary (e.g., Grabowski and Vernon, 1992, and Frank and Salkever, 1997).

² Our results are consistent with a literature that focuses on firm strategies and investments to affect brand loyalty by increasing switching cost across brands (for example, Beggs and Klemperer 1992, Farrell and Shapiro, 1988, Klemperer 1995, Schmalensee and Willig 1986), however, the strategies examined in these models do not seem particularly relevant for orange juice.

³ Refrigerated, frozen, and shelf stable orange juice are sold in most stores. We examine consumers' switching behavior for only refrigerated and frozen orange juice because shelf stable sales account for less than 1 percent of the total purchases of orange juice in our household level data.

We start by describing our empirical modeling approach. Then, we describe the data and define our variables. In the next section, we discuss summary statistics. In the last three sections, we present our two formal empirical analyses and draw conclusions.

2. The Empirical Model

We investigate the relationship between switching behavior and consumer demographics using multinomial logit. We use two approaches with two different dependent variables but the same explanatory variables, household characteristics and sales frequency. First, we examine the shares of purchases consumers make of each brand or type of orange juice. Second, we classify consumers as being loyal customers or switchers.

Our frequency of sales variable is the percentage of weeks for which the product or group of products are on sale at a given store. Presumably in the absence of sales, even non-loyal consumers have little incentive to switch between brands if the “usual” (modal) price remains constant. The theoretical literature presumes that one exogenously given group, the loyal customers, do not react to sales, while switchers do respond to sales.

One concern that major national brands have is that during a sale, their loyal customers stock up on frozen products; and, in subsequent period, these customers reduce their purchases while they use up the stored goods. In this view, the only desirable effect of a sale is that it induces some switchers who would not otherwise purchase this brand to buy and store this brand. If this view is correct, all else the same, we would expect to see a more dramatic effect of sales on switchers for frozen products that can be stored than for refrigerated products that cannot be stored.

Our first analysis, which examines whether the shares of brands are sensitive to changes in sales frequency, could be interpreted loosely as estimating a system of demand equations. During 1999, the modal prices of orange juice (the prices that are usually observed) did not trend substantially. Thus, differences in relative prices across brands were due almost entirely to differences in sales frequencies. As the sales frequency rises, we expect the share of consumers buying a given brand to increase.

However, this increase in share may be due solely to consumers who are price sensitive (switchers) rather than changes in the share of consumers who remain loyal. Thus, in our second analysis, we examine whether the share of consumers who remain loyal is sensitive to changes in sales frequency. If the share of those who remain loyal is sensitive to sales frequencies, then the presumption in the theoretical literature that loyal customers are exogenously determined must be rejected.

We use cross-sectional, time series data on household purchases of orange juice from cities across the country. The household characteristics include ages of female and male heads, income, household size, education and occupation of the heads, and presence of young kids. Wealthy families may ignore sales. Presumably, a lower-income, larger-size household is more prone to buy the least expensive product—switch when sales occur—and thus exhibit less loyalty to particular brands. Similarly, brand loyalty may differ with the age of children. Older children may prefer brands more strongly than younger ones or parents who believe that certain brands of orange juice are more nutritious may be more inclined to buy a single brand for younger children. Some speculation in the press holds that educated families are more likely to buy generics—be less loyal—than other families.

We believe that it is reasonable to assume that consumers view the sales frequency variables as exogenous. It seems unlikely that the frequency of sales of orange juice products alone substantially affects consumers' choice of which grocery store they are most likely to shop in over a year. In our entire sample, the average probability that a consumer buys orange juice on sale is 17.2 percent if the consumer shops at the store he visits most frequently and 17.4 percent at other stores.⁴

One might also be concerned about endogeneity problems arising from stores' reactions to consumers' choices, which vary with consumers' characteristics.⁵ We regressed the frequency of sales in stores on the characteristics of its customers and found no correlation (indeed, no coefficient had a t-statistic as high as one). In short, we have no compelling evidence as to why the frequency of sales varies across stores and view these decisions as essentially exogenous for our purposes.

3. Data

We use Information Resources Incorporated's (IRI) InfoScan® Household Paneldata for 1999. IRI collects data on individual purchases from grocery stores and on prices directly from grocery stores' databases and in other ways. The store-level data set includes weekly prices, total sales quantities, promotion activities (price reduction, special display, retail ads, and any other type of promo-

⁴ Unfortunately, we lack appropriate instruments that would allow us to test for potential endogeneity directly. However, Rhee and Bell (2002) report that they fail to find a relationship between consumers' observable demographics and their decisions to switch between stores after controlling for unobserved heterogeneity. Bell, Ho, and Tang (1998) cite industry research that location explains up to 70 percent of the variance in consumers' supermarket choice decisions.

⁵ Because we do not know how many rival grocery stores are located in the general vicinity of any given store, we cannot examine the role of such competition in determining the frequency of sales. However, given the evidence in the previous footnote, such competition may play a relatively minor role in determining sales frequencies.

tion excluding coupons), and other information by product UPC (Universal Product Code).

The IRI customer database includes weekly purchases by individual households and annual (or time-invariant) demographic information for each household for 24 cities.⁶ This dataset has detailed information on the number of visits to grocery stores by a household, total units of products the household bought by UPC in each visit, and price per unit paid. We have annual demographic data for each household on annual household income, household size, age, employment status/occupation, and educational levels of the female and male heads of the households.

Our analyses use three subsamples of our the IRI dataset: refrigerated orange juice, frozen orange juice, and combined—both types—of orange juice so that we can examine the degree of loyalty within and across each type of orange juice. In the frozen (refrigerated) sample, we include all households that bought frozen (refrigerated) products at least twice in 1999. The combined sample includes all households who bought either frozen or refrigerated orange juice products at least twice in 1999. There are 10,368, 4,289, and 12,578 households in the refrigerated, frozen and combined subsample respectively.⁷ We use one observation per household for 1999.

For the refrigerated and frozen samples, we calculate the percentage of shopping trips in which a household bought private-label (PL) products, major national brands (NBs), and minor national brands out of total number of purchases of the particular type of orange juice during 1999. Thus, we are examining switching behavior—or loyalty—across groups of brands. We say that a household is loyal to a brand if it only buys that brand during a fixed period of time.⁸ These three proportions sum to one for each household in each sample. We define the “major” national brands as those that had the largest national market shares based on our store-level data. The major refrigerated brands are Tropicana, Minute Maid, and Florida Natural, which collectively accounted for about 60 percent of the refrigerated orange juices market with each having

⁶ The IRI cities are Atlanta; Boston; Cedar Rapids, IA; Chicago; Denver; Detroit; Eau Claire, WI; Grand Junction, CO; Houston; Kansas City; Los Angeles; Memphis; Midland, TX; Minneapolis/St. Paul; New York; Philadelphia; Pittsburgh; Pittsfield, MA; Rome, GA; San Francisco/Oakland; Seattle/Tacoma; St. Louis; Tampa/St. Petersburg; and Visalia, CA.

⁷ Our sample consists of 25,406 households, of which 10,658 households bought frozen orange juice products and 21,806 households bought refrigerated products. After dropping households who bought these products fewer than twice during the year, we are left with 7,258 households in the frozen sample, 17,653 households in the refrigerated sample, and 21,621 households in the combined sample. We had to drop some additional households for which we could not appropriately assign household demographics. After doing so, we are left with 4,289, 10,368, and 12,578 in our frozen, refrigerated, and combined sample respectively.

⁸ Several alternative approaches have been used in other settings (Jacoby and Kyner, 1973; Jacoby and Chestnut, 1978; Colombo and Morrison, 1989; and Bayus, 1992).

double-digit shares. Minute Maid, our only major frozen brand, had about 40 percent of the market share (the runner-up brand accounted for just 3 percent).

In the combined model, we examine six shares: three each for refrigerated and frozen orange juice. Here, the percentage of customers buying a certain category is defined as the number of times the household bought these brands relative to the total number of times buying any type of orange juice. The combined sample has customers who are loyal to a national brand, those who switch between brands within a type, and those who switch between types.⁹

Our objective is to examine how a grocery store's sales activity affects its customers' choices across brands, controlling for consumer characteristics. Our key variables are the frequencies of sales within the 1999 calendar year for private labels, major name brands, and minor national brands. The frequency of sales is calculated for the store at which a given household most often purchases orange juice.¹⁰ Sales frequency is defined as the percentage of weeks in 1999 that a price reduction is observed for any product of the relevant brands. To determine whether a product or group of products is on sale, we use IRI's variable that measures the "presence of price reduction."¹¹ These sales frequencies vary considerably across stores.

In our second approach, we assign households to one of a mutually exclusive and exhaustive set of groups based on their switching behavior in each of the three samples. The groups are

Refrigerated sample and frozen sample:

1. *Major name brand loyal:* Throughout 1999, the household bought only the major national brands (Tropicana, Minute Maid, and Florida Natural in the refrigerated sample, only Minute Maid in the frozen sample).¹²
2. *Private label loyal:* The household always bought the private label.¹³

⁹ These results are robust to changes in our categorization schemes. We experimented with alternative categorizations. For example, we divided the major refrigerated national brands category into individual national brands and did not find that our results are sensitive to this change. Therefore, we present our simplest specification.

¹⁰ About half of the households in each of our samples made all their orange juice purchases in just one store, less than one third in two stores, and less than 7 percent bought from three stores during 1999. It is possible that a household sometimes purchased orange juice from a store not included in IRI's sample, though it is extremely unlikely that a household made most of its purchases at such a store.

¹¹ We experimented with alternative definition of sales. Hendel and Nevo, 2002, considered the fractions 5 percent, 10 percent, 25 percent, or 50 percent. We consider such percentage price reduction from the annual price mode, most of which are larger reductions than in IRI's definition. We found that our qualitative results are generally not sensitive to the definition of sales.

¹² Among the 2,734 households who are loyal to one or more of the major name brands, 44 percent are loyal to a single brand, 39 percent switch across two brands, and the rest switch across all three.

3. *Switches between private label and name brands*: The household switched between the private label and either the leading national brands or the other national brands.
4. *Some other national brands*: The household either buys only the other national brands, or the household switches between major name brands and the others national brands.
5. *Every category*: The household buys at least once private label, a major name brand, and another national brand.

Combined Sample

1. *Only frozen*: During the year, the household bought frozen orange juice exclusively.
2. *Only refrigerated*: The household bought only refrigerated orange juice during the year.
3. *Switches across types*: The household bought both frozen and refrigerated orange juice during the year.

Although these categories are arbitrary, when we experimented with other categorizations we obtained qualitatively similar results to those we report.

4. Summary Statistics

We present summary statistics for the refrigerated orange juice, frozen orange juice, and combined samples in Tables 1 and 2. We have four results about loyalty from these and other summary statistics:

Table 1: Length of Time and Brand Loyalty

<i>Period</i>	<i>Brand</i>		<i>Type</i>
	<i>Refrigerated</i>	<i>Frozen</i>	<i>Combined</i>
6 months	23.1	51.6	53.7
1 year	17.2	39.8	40.5

¹³ We considered whether it is a misnomer to refer to households as “private label (PL) loyalty.” Are such consumers loyal, or are they merely buying the private label because it is the least expensive brand? We examined whether the products that PL loyal households bought were the least expensive in that week and found that, controlling for item size, the private label product was the least expensive product in 74% of the store-weeks. However, controlling for size, the PL loyal households bought the least expensive product only 24% of the time.

2 years	13.9	33.9	31.5
3 years	12.2	29.5	27.3

Result 1: Switching behavior is extremely common and brand loyalty is relatively uncommon for orange juice. In the refrigerated sample, less than a fifth of the households, 17.2 percent, are loyal to a particular brand throughout the year (Table 1, second row, first column), nearly one-third of the households buy two brands of refrigerated products, and the rest of the households purchases three or more brands. Frozen orange juice consumers show more brand loyalty than their refrigerated counterparts, probably because there are fewer choices in the frozen market. Nearly four in ten households buy a single brand of frozen orange juice, another four out of ten households switch across two brands, and the remaining two out of ten bought more than three brands during the year.

Result 2: The share of consumers who remain loyal to a brand drops substantially over time. Over a longer period, the fraction of consumers who remain loyal drops. As Table 1 shows for each of the three samples, the share of households who remain loyal to a particular brand or a particular type of orange juice drops as the period of observation becomes longer. In a six-month period, over half the households in the frozen sample and nearly a quarter in the refrigerated sample exclusively bought one brand. However, over a one-year period, these shares fall to 39 percent and 17 percent respectively. Over three years, these figures drop to 30 percent and 12 percent. Similarly, the share of households buying a single type of juice in the combined sample dropped nearly in half if we look at a three-year period rather than a half-year period.

Result 3: Looking only within frozen or within refrigerated juices provides a misleading picture that there is more loyalty than when we take account of switching between types. We find substantially less national brand loyalty if we allow consumers to switch between frozen and refrigerated products than if we look at just one or the other type of juice: The share of consumers who stick to only one brand over the year decreases to only 8.64 percent. Indeed, the share of consumers who are loyal to one type of orange juice over a year is only 40.5 percent (Table 1).

Result 4: Refrigerated orange juice consumers are more likely to be loyal to a major brand than are frozen orange juice customers. Of frozen orange juice consumers, 16 percent are loyal over the year to Minute Maid and 25 percent to the private label (not shown in the tables). In contrast for those who consume refrigerated orange juice, 26 percent are loyal to the top three name brands brand name and only 6 percent to the private label.

Table 2 shows that the means of the explanatory variables vary little across the samples. Families with small children are slightly more likely to buy frozen orange juice or switch than to buy the more expensive refrigerated juice (Table 2).

Slightly more of families with incomes over \$100,000 buy refrigerated rather than frozen juice.¹⁴

Table 2 also shows the frequency of sales by brands and types. We have two additional results.

Result 5: Refrigerated major national brands are on sale much more frequently than other brands of either type products. At least one of the three major national refrigerated brands is on sale over two-thirds of the time. In contrast, the refrigerated private label is on sale about 40 percent, the minor refrigerated brands have sales a third of the time, and the frozen products are on sale no more than 30 percent of the time.

Result 6: Contrary to popular perception, private label products are on sale as frequently as many national brands. The frozen private label product is on sale 30 percent of the time compared to a quarter of the time for Minute Maid and slightly less for the minor frozen brands. The refrigerated private label is likely to be on sale nearly 40 percent of the time, which exceeds the one third probability that any minor refrigerate national brand is on sale.

We now turn to our two formal analyses of the effect of sales on purchase frequency and on loyalty. Both analyses are designed to determine how the frequency of sales at a store and various consumer characteristics affect consumers' purchasing behavior holding other factors constant. The first analysis explores how sales and demographics affect the probabilities that households buy particular groups of brands or types of orange juice. The second analysis estimates the probability that households remain loyal to a particular group of brands.

Table 2: Summary Statistics for the Three Samples

	<i>Refrigerated</i>	<i>Frozen</i>	<i>Combined</i>
<i>Percentage buying</i>			
Frozen private label	-	51.4 (39.3)	13.1 (26.2)
Frozen Minute Maid	-	33.9 (37.9)	8.6 (21.5)
Frozen minor national brands	-	14.8 (25.6)	3.6 (12.1)
Refrigerated private label	0.274 (32.1)	-	20.0 (27.9)

¹⁴ IRI reports income in ranges and top codes incomes above \$100,000. Consequently, we use two income measures. One is the midpoint of a household's annual income bracket if its income is less than \$100,000. The other is a dummy if the income exceeds \$100,000.

Refrigerated major national brands	59.6 (36.6)	-	45.5 (38.6)
Refrigerated minor national brands	12.9 (22.9)	-	14.0 (26.4)
<i>Percentage of weeks on sale</i>			
Frozen private label	-	30.08 (19.45)	30.85 (19.48)
Frozen Minute Maid	-	25.15 (23.02)	25.59 (22.24)
Frozen minor national brands	-	23.28 (25.28)	21.79 (22.95)
Refrigerated private label	39.59 (21.86)	-	38.27 (22.08)
Refrigerated major national brands	69.33 (24.19)	-	68.32 (24.36)
Refrigerated minor national brands	33.04 (29.37)	-	32.07 (29.10)
Household demographics			
Household Size (number)	2.80 (1.31)	2.86 (1.35)	2.79 (1.31)
Household's annual income (midpoint of bracket, \$ thousands)	39.72 (22.95)	38.55 (21.63)	39.39 (22.70)
Households with income > \$100,000 (%)	2.3	1.8	2.2
Presence of children under 6 (%)	6.5	8.5	6.8
Male head employed full time (%)	51.9	52.7	51.8
Female head employed full time (%)	54.7	53.5	54.5
Male white-collar (%)	36.9	38.5	37.0
Female white-collar (%)	45.0	42.8	44.3
Male no college (%)	27.8	24.2	27.2
Female no college (%)	40.0	34.6	39.0
White (%)	91.5	93.4	92.0
Home owner (%)	86.9	88.5	87.1

Note: Standard errors for continuous variables are reported in parenthesis.

5. Brand-Share Analysis

We start by estimating brand-share multinomial logit models for each of our three samples. Table 3 shows the estimates for the refrigerated and for the frozen samples where the dependent variables are the fraction of households that purchase the private label, the major national brand or brands, and the minor national brands (which is the residual category).

For very few of the household demographics can we reject the null hypothesis at the 0.05 level that their coefficients are zero except for household size and income. All the frequency of sales of the private label and the minor

national brands are statistically significantly different from zero, whereas only one of the four coefficients for the frequency of sales of the major national brands is.

Table 4 shows the marginal effects of changing each individual variable holding the other variables constant at their mean values. For a continuous variable, the table shows the partial derivative of the estimated share with respect to a change in that variable. For example, a one percent increase in a household's income (for households earning less than \$100,000 per year) causes a 0.158 decrease in the share of households that buy refrigerated private label products. For a dummy variable, the table reports the difference in the dependent variable when the dummy is one minus when it is zero where all other variables are evaluated at their means. For example, a household with a male head who is employed buys 6.405 percentage points less frozen private label products than a household with an unemployed male head.

The demographic characteristics that are statistically significant generally have the expected effect. Larger families and poorer families are more likely to buy a private label product and less likely to buy a major national brand for either refrigerated or frozen orange juice. We see the same pattern for families whose male head is unemployed for frozen orange juice. A household earning over \$100,000 compared to one earning the average income of about \$40,000, has about a 15 percent lower probability of buying frozen private label orange juice and about a 16 percent greater probability of buying frozen Minute Maid.

As we expected, as the frequency of sales increases for a product, the fraction of households buying that product increases. The effect of a sale of one product on the percentage of households buying another product is negative or statistically insignificant, with one exception (a sale of minor brands on the share of households buying Minute Maid). For example, a one percent increase in the frequency of private label sales causes a 0.321 percent increase in the share of households that buy a frozen private label product, but decreases the sales of frozen Minute Maid by nearly the same amount (-0.301 percent). To summarize:

Table 3: Multinomial Logit Estimates for Brand Shares, Refrigerated and Frozen Samples

	<i>Refrigerated</i>		<i>Frozen</i>	
	<i>Private Label</i>	<i>Major NBs</i>	<i>Private label</i>	<i>Minute Maid</i>
<i>Sales frequency</i> (% of weeks)				
Private label	0.029 (0.002)	0.011 (0.001)	0.008 (0.003)	-0.007 (0.003)
Major national brands	0.000 (0.002)	0.010 (0.002)	0.000 (0.002)	0.004 (0.002)
Minor national brands	-0.026 (0.002)	-0.032 (0.001)	-0.036 (0.002)	-0.025 (0.002)
Household Size	0.042 (0.032)	-0.083 (0.029)	0.038 (0.045)	-0.037 (0.047)
Household's annual income (midpoint of bracket, \$ thousands)	-0.001 (0.002)	0.008 (0.002)	0.001 (0.003)	0.010 (0.003)
Household income > \$100,000	-0.175 (0.293)	0.903 (0.256)	-0.221 (0.396)	0.539 (0.397)
Presence of kids under 6	0.063 (0.151)	0.156 (0.140)	-0.0145 (0.195)	0.263 (0.196)
Male full time employed	-0.008 (0.103)	-0.093 (0.095)	-0.252 (0.151)	0.007 (0.156)
Female full time employed	0.041 (0.075)	0.017 (0.068)	0.101 (0.103)	0.137 (0.107)
Male white-collar	0.152 (0.100)	0.217 (0.092)	0.150 (0.140)	0.044 (0.144)
Female white-collar	-0.018 (0.078)	-0.067 (0.071)	-0.157 (0.110)	-0.190 (0.113)
Male no college	-0.145 (0.083)	-0.181 (0.076)	0.135 (0.124)	-0.015 (0.130)
Female no college	0.005 (0.079)	0.022 (0.072)	-0.052 (0.111)	0.009 (0.116)
White	-0.090 (0.133)	-0.176 (0.121)	0.049 (0.212)	0.061 (0.219)
Home Owner	-0.115 (0.110)	-0.184 (0.101)	0.089 (0.158)	-0.100 (0.164)
Constant	0.798 (0.207)	1.935 (0.189)	1.860 (0.288)	1.428 (0.298)
Number of observations	10,368		4,289	
χ^2	1,135		507	

Note: Numbers in parenthesis are asymptotic standard errors. The coefficient is bold if we can reject the null hypothesis that the coefficient is zero at the 0.05 level.

Table 4: Marginal Effects for Brand Shares, Refrigerated and Frozen Samples

	<i>Refrigerated</i>			<i>Frozen</i>		
	<i>Private label</i>	<i>Major NBs</i>	<i>Minor NBs</i>	<i>Private label</i>	<i>Minute Maid</i>	<i>Minor NBs</i>
<i>Sales frequency (% weeks)</i>						
Private label	0.384 (0.025)	-0.228 (0.024)	-0.157 (0.016)	0.321 (0.049)	-0.301 (0.046)	-0.020 (0.028)
Major national brands	-0.179 (0.026)	0.244 (0.027)	-0.064 (0.017)	-0.070 (0.039)	0.090 (0.037)	-0.020 (0.025)
Minor national brands	0.025 (0.020)	-0.311 (0.023)	0.287 (0.020)	-0.448 (0.043)	0.098 (0.037)	0.350 (0.032)
Household Size	2.252 (0.412)	-2.677 (0.449)	0.425 (0.272)	1.625 (0.747)	-1.536 (0.709)	-0.088 (0.471)
Household's annual income (midpoint of bracket)	-0.158 (0.027)	0.204 (0.028)	-0.046 (0.017)	-0.164 (0.048)	0.213 (0.045)	-0.049 (0.031)
Household income > \$100,000	-18.823 (3.838)	24.262 (3.951)	-5.438 (2.426)	-15.411 (6.412)	16.323 (5.897)	-0.913 (4.088)
Presence of kids under 6	-1.395 (1.903)	2.611 (2.082)	-1.216 (1.296)	-5.199 (3.055)	6.252 (2.812)	-1.053 (2.025)
Male full time employed	1.417 (1.355)	-2.055 (1.469)	0.638 (0.875)	-6.405 (2.481)	4.780 (2.353)	1.625 (1.577)
Female full time employed	0.535 (0.970)	-0.302 (1.050)	-0.233 (0.630)	0.006 (1.713)	1.260 (1.623)	-1.266 (1.076)
Male white-collar	-0.650 (1.298)	2.525 (1.412)	-1.875 (0.853)	2.933 (2.325)	-1.754 (2.186)	-1.178 (1.457)
Female white-collar	0.784 (1.011)	-1.282 (1.096)	0.498 (0.662)	-0.437 (1.803)	-1.426 (1.698)	1.863 (1.155)
Male no college	0.186 (1.093)	-1.805 (1.186)	1.620 (0.705)	3.638 (2.040)	-2.819 (1.955)	-0.819 (1.299)
Female no college	-0.273 (1.030)	0.435 (1.115)	-0.162 (0.665)	-1.475 (1.855)	1.171 (1.761)	0.304 (1.160)
White	1.205 (1.647)	-2.629 (1.785)	1.424 (1.134)	0.106 (3.223)	0.488 (3.043)	-0.594 (2.231)
Home owner	0.826 (1.372)	-2.375 (1.494)	1.550 (0.939)	4.051 (2.561)	-3.906 (2.427)	-0.145 (1.657)
Predicted probability for a typical household (%)	27.5	6.19	10.7	52.5	35	12.5

Note: Numbers in parenthesis are asymptotic standard errors. Bold indicates that we can reject the null hypothesis that the coefficient for this variable is zero at the 0.05 level.

We can use these estimated equations to simulate the effects of changes in sales on the shares of consumers buying private label products, major national

brands, and minor national brands, as Table 5 shows. We allow the frequency of sales to vary between zero and one hundred percent because we observe such a range for most categories (at given time one or another brand may be on sale in a category that contains several brands). The simulations show that a change in sales frequency can have a substantial effect on brand shares. For example, as the sales frequency of major refrigerated national brands increases from zero to hundred percent, the share of consumers buying major national brands increases 25 percentage points from 44 percent to 69 percent. Correspondingly, the share buying private label plummets from 41 percent to 22 percent, and the share of those buying minor national brands falls from 15 percent to 9 percent. Similarly, as the sales frequency of minor frozen national brands rises from zero to 100 percent, the share of people buying the national brands skyrockets from 6 percent to 60 percent, people stop buying private label products (the share falls from 62 percent to 15 percent), and the share of those buying the major brand, Minute Maid, tumbles from 32 percent to 24 percent.

Table 5: Simulation of the Effect of Changes in Sales Frequencies on Brand Shares, Refrigerated and Frozen Samples (%)

<i>Categories</i>	<i>Sales frequency (%)</i>	<i>Refrigerated Sample</i>			<i>Frozen Sample</i>		
		<i>Private label</i>	<i>Major NBs</i>	<i>Minor NBs</i>	<i>Private label</i>	<i>Minute Maid</i>	<i>Minor NBs</i>
Private label	0	14.91	67.42	17.67	42.95	44.24	12.81
	25	22.29	64.82	12.90	51.05	36.39	12.56
	50	31.72	59.32	8.96	58.95	29.08	11.97
	75	42.73	51.38	5.89	66.28	22.62	11.10
	100	54.33	42.01	3.66	72.76	17.18	10.06
Major national brand(s)	0	40.72	44.29	14.99	54.42	32.62	12.96
	25	35.90	50.73	13.38	52.71	34.82	12.47
	50	31.12	57.14	11.74	50.93	37.10	11.97
	75	26.55	63.32	10.13	49.10	39.43	11.47
	100	22.30	69.09	8.61	47.23	41.81	10.96
Minor national brands	0	25.68	70.17	4.15	62.16	31.56	6.29
	25	27.28	64.28	8.44	51.93	35.00	13.07
	50	27.59	56.07	16.34	39.66	35.50	24.84
	75	25.73	45.09	29.19	26.69	31.72	41.59
	100	21.35	32.26	46.39	15.49	24.45	60.06

Result 8: The shares of refrigerated and frozen brands are very sensitive and roughly equally sensitive to sales frequency. That is, we do not find strong

evidence to support the hypothesis that storable frozen goods are more sensitive to sales than are unstorable refrigerated products.

We now turn to the combined sample, where consumers can switch between frozen and refrigerated orange juice as well as between brands within a type. Henceforth to save space, we only report the marginal effects tables (the tables of coefficients are available from the authors). Table 6 shows the marginal effects for the combined samples.

Again, larger families and poorer families are more likely to buy private label products. The relationship between sales frequency and purchasing behavior is more complex than when we looked at only a single type of orange juice. For example, when frozen private label orange juice is on sale more frequently, the share of the frozen private label rises as does the share of types of minor national brands, while the shares for the refrigerated private label and the refrigerated major national brands fall. Except for frozen Minute Maid, the effect of more frequent sales on a brand's own share is positive.

Again, the simulation effects, Table 7, can be substantial. When the sales frequency of minor refrigerated brands goes from zero to one hundred percent, the share of minor refrigerated brands shoots up from 3 percent to 37 percent, the major refrigerated brands share dives from 47 to 28 percent, the refrigerated private label's share is little changed, but the frozen private label's share tumbles from 16 percent to 9 percent.

Thus in all three samples, we find that, the more often a brand is on sale, the more likely are households to buy it: controlling for demographic characteristics, an increase in sales frequency increases the brand's own share at the expense of other brands' shares in net. Moreover, the simulations show that the brand shares can change dramatically as the sales frequency increases.

6. Loyalty Analysis

So far, we've looked at the effect of sales frequency on brand shares. It is possible that some households switch between brands in response to sales while others remain loyal. Given that the frequency of sales varies substantially across stores (see the standard deviations in Table 2), we can examine whether that story is correct or whether the share that remains loyal to a brand is sensitive to the frequency of sales.

In this analysis, we divide consumers into groups based on whether they remained loyal to a brand or switched between brands in 1999. The multinomial logit fits reasonably well, correctly predicting 39% of the refrigerated and 37% of the frozen categories.

Table 6: Marginal Effects for Brand Shares, Combined Sample

	<i>Refrigerated</i>			<i>Frozen</i>		
	<i>Private label</i>	<i>Major NBs</i>	<i>Minor NBs</i>	<i>Private label</i>	<i>Minute Maid</i>	<i>Minor NBs</i>
<i>Sales frequency</i> (% of weeks)						
Frozen private label	-0.126 (0.024)	-0.088 (0.030)	0.063 (0.015)	0.142 (0.022)	-0.013 (0.017)	0.022 (0.008)
Frozen Minute Maid	0.121 (0.019)	-0.009 (0.023)	-0.064 (0.012)	-0.027 (0.016)	-0.009 (0.013)	-0.012 (0.008)
Frozen minor national brands	-0.100 (0.022)	-0.127 (0.028)	-0.007 (0.012)	0.019 (0.020)	0.104 (0.016)	0.110 (0.012)
Refrigerated private label	0.379 (0.023)	0.007 (0.024)	-0.125 (0.014)	-0.122 (0.018)	-0.020 (0.015)	-0.017 (0.008)
Refrigerated major national brands	-0.099 (0.023)	0.283 (0.028)	-0.025 (0.014)	-0.116 (0.019)	-0.020 (0.015)	-0.024 (0.009)
Refrigerated minor national brands	0.058 (0.018)	-0.144 (0.023)	0.213 (0.017)	-0.049 (0.017)	-0.062 (0.014)	-0.015 (0.007)
Household Size	1.441 (0.334)	-2.354 (0.432)	0.240 (0.211)	0.634 (0.284)	-0.147 (0.233)	0.186 (0.122)
Household's annual income (midpoint of bracket, \$ thousands)	-0.070 (0.022)	0.246 (0.027)	-0.019 (0.013)	-0.121 (0.019)	-0.006 (0.014)	-0.030 (0.009)
Household income > \$100,000	-8.622 (3.161)	27.390 (3.593)	-2.297 (1.862)	-12.645 (2.802)	-1.007 (1.848)	-2.819 (1.219)
Presence of kids under 6	-2.536 (1.562)	-1.640 (1.947)	-1.251 (1.003)	1.839 (1.230)	3.391 (0.925)	0.197 (0.530)
Male full time employed	1.083 (1.096)	-1.904 (1.394)	0.185 (0.668)	-0.592 (0.936)	0.846 (0.772)	0.382 (0.406)
Female full time employed	0.504 (0.791)	-0.435 (0.988)	-0.175 (0.483)	-0.001 (0.658)	0.388 (0.536)	-0.280 (0.281)
Male white-collar	-1.691 (1.054)	0.843 (1.337)	-1.169 (0.651)	1.669 (0.901)	0.542 (0.723)	-0.193 (0.378)
Female white-collar	1.131 (0.825)	0.614 (1.031)	0.751 (0.510)	-1.518 (0.694)	-1.116 (0.555)	0.137 (0.297)
Male no college	1.141 (0.886)	-0.239 (1.134)	1.502 (0.541)	-0.182 (0.757)	-1.731 (0.663)	-0.492 (0.337)
Female no college	1.568 (0.840)	3.691 (1.061)	0.685 (0.514)	-3.483 (0.726)	-1.888 (0.600)	-0.573 (0.308)
White	-0.802 (1.339)	-5.743 (1.711)	-0.758 (0.851)	3.338 (1.227)	3.230 (1.062)	0.735 (0.608)
Home owner	-0.734 (1.104)	-4.597 (1.418)	0.733 (0.725)	3.312 (0.986)	1.053 (0.804)	0.233 (0.422)
Predicted probability for a typical household	19.9	48.5	7.5	1.3	8.4	2.7

Note: Numbers in parenthesis are asymptotic standard errors. Bold indicates that we can reject the null hypothesis that the coefficient is zero at the 0.05 level. The χ^2 statistic for all the coefficients is 772. There are 12,578 observations.

Table 7: Simulation of the Effect of Changes in Sales Frequencies on Brand Shares, Combined Sample

Categories	Sales frequency (%)	Refrigerated			Frozen		
		Private label	Major NBs	Minor NBs	Private label	Minute Maid	Minor NBs
Frozen private label	0	24.4	46.4	5.5	10.1	11.1	2.6
	25	20.8	44.9	6.8	13.5	10.8	3.2
	50	17.4	42.6	8.3	17.7	10.2	3.9
	75	14.2	39.3	9.8	22.6	9.4	4.6
	100	11.3	35.4	11.4	28.2	8.5	5.3
Frozen Minute Maid	0	16.8	44.6	8.8	15.2	11.0	3.7
	25	19.9	44.5	7.2	14.4	10.7	3.4
	50	23.5	43.9	5.8	13.5	10.3	3.0
	75	27.3	43.0	4.7	12.6	9.8	2.7
	100	31.5	41.6	3.7	11.6	9.3	2.3
Frozen minor national brands	0	22.2	47.1	7.2	14.0	8.2	1.4
	25	19.7	44.0	7.1	14.4	11.1	3.8
	50	16.5	38.8	6.6	14.1	14.2	9.8
	75	12.4	30.7	5.5	12.3	16.4	22.7
	100	7.8	20.2	3.8	8.9	15.6	43.8
Refrigerated private label	0	8.6	39.6	12.2	18.8	16.9	3.9
	25	15.2	43.6	8.8	16.1	12.8	3.6
	50	25.0	44.4	5.8	12.8	8.9	3.1
	75	37.5	41.5	3.6	9.3	5.7	2.4
	100	51.4	35.3	2.0	6.2	3.4	1.7
Refrigerated major national brands	0	25.4	26.6	7.9	24.0	11.0	5.2
	25	23.7	32.7	7.8	20.3	11.1	4.5
	50	21.7	39.4	7.5	16.8	10.9	3.8
	75	19.4	46.3	7.0	13.6	10.6	3.2
	100	17.0	53.4	6.4	10.7	9.9	2.6
Refrigerated minor national brands	0	17.4	47.0	2.8	15.7	13.2	3.9
	25	19.5	45.2	5.8	14.7	11.3	3.5
	50	21.0	41.8	11.7	13.3	9.2	3.0
	75	21.1	36.2	22.0	11.2	7.0	2.4
	100	19.2	28.3	37.4	8.6	4.8	1.7

Table 8 shows the marginal effects for the refrigerated and frozen samples. An increase in the sales frequency of a group of brands increases not only the probability that a household is loyal to that group, but also the probability that the

household switches from other brands to it. For example, a 1 percent increase in refrigerated private label sales frequency increases the probability that a household buys only the private label by 0.16 percentage points or that it switches between the private label and national brands by 0.26 percentage points. It reduces the probability that the household is loyal to major name brands by 0.24 percentage points or buying minor national brands along or with major national brands by 0.20 percentage points.

Table 9 shows the marginal effects for the combined sample. An increase of sales frequency in either the frozen private label or the frozen minor brands will encourage consumers to buy the frozen products exclusively or to switch across types. However, an increase in the sales frequency of frozen Minute Maid discourages across-type switching and raises the probability that a household buys only its product. Meanwhile, a higher sales frequency in all the refrigerated products results in less switching across types, less buying frozen type only and more exclusive buying refrigerated. A possible explanation for the asymmetry is that frozen products are easier to store than the refrigerated orange juice, hence households could stock up on frozen products that on sales and use them as a substitute for refrigerated products when they run out of refrigerated products.

We also looked at loyalty to a type of orange juice— refrigerated or frozen—in Table 10, which shows the marginal effects. Here, demographic characteristics matter more than in most of our other analyses. In addition to the usual household size and income variables, other statistically significant characteristics include the presence of children less than six years of age, whether the mother is a white collar worker, whether the father or the mother has a college education, race, and homeownership (a proxy for wealth). With the exception of frozen Minute Maid, an increase in sales frequency of a brand of a particular type tends to increase the probability that a household is loyal to that type. An increase in the sales frequency for a frozen brand tends to increase the odds that a household shifts between frozen and refrigerated orange juice; whereas, an increase in the frequency for a refrigerated product tends to reduce switching. This last result may be partially due to the larger share of households that buy refrigerated products.

Table 11 uses this last multinomial logit model to simulate the effects of increased frequency of sales over a larger range. The simulation findings are similar to that of the marginal analyses.

Table 8: Marginal Effects on Group Membership, Refrigerated and Frozen Samples

	Refrigerated					Frozen				
	Major NBs only	PL only	Minor NBs included	PL & NBs	All brands	Minute Maid only	PL only	Minor NBs included	PL & NBs	All brands
Sales frequency										
Private label	-0.24 (0.03)	0.16 (0.02)	-0.21 (0.02)	0.26 (0.03)	0.03 (0.02)	-0.16 (0.04)	0.27 (0.04)	-0.10 (0.02)	0.029 (0.05)	-0.03 (0.03)
Major NBs	0.05 (0.02)	-0.09 (0.02)	0.05 (0.02)	-0.27 (0.03)	0.21 (0.03)	0.05 (0.03)	-0.08 (0.03)	0.02 (0.02)	0.022 (0.04)	-0.02 (0.03)
Minor NBs	-0.20 (0.02)	0.03 (0.01)	0.25 (0.02)	-0.29 (0.02)	0.21 (0.019)	0.03 (0.03)	-0.41 (0.05)	0.26 (0.03)	-0.13 (0.04)	0.25 (0.03)
Household Size	-3.67 (0.46)	0.72 (0.20)	0.14 (0.29)	0.93 (0.45)	1.88 (0.38)	-1.65 (0.56)	0.69 (0.62)	-0.159 (0.36)	0.34 (0.72)	0.77 (0.52)
HH's annual income	0.18 (0.03)	-0.05 (0.00)	0.02 (0.02)	-0.09 (0.03)	-0.06 (0.02)	0.17 (0.04)	-0.10 (0.04)	-0.01 (0.02)	-0.05 (0.05)	-0.02 (0.03)
HH's income > \$100,000	20.02 (3.25)	-6.90 (2.24)	3.59 (2.17)	-10.53 (3.93)	-6.17 (3.32)	14.86 (4.20)	-7.66 (5.62)	0.93 (3.12)	-2.11 (6.30)	-6.02 (5.38)
Presence of kids under 6	6.64 (1.93)	-1.00 (0.95)	-3.73 (1.48)	-2.27 (2.13)	0.35 (1.72)	4.93 (2.06)	-2.95 (2.63)	-0.27 (1.52)	-1.90 (2.98)	0.19 (2.18)
Male full time employed	0.26 (1.40)	0.83 (0.67)	0.14 (0.94)	-1.60 (1.49)	0.36 (1.23)	4.42 (1.84)	-4.25 (2.05)	3.15 (1.28)	-0.35 (2.39)	-2.97 (1.77)
Female full time employed	0.74 (0.99)	0.69 (0.49)	-0.22 (0.67)	1.58 (1.06)	-2.78 (0.88)	1.61 (1.27)	2.22 (1.43)	-0.95 (0.84)	-1.55 (1.65)	-1.32 (1.20)
Male white-collar	2.22 (1.35)	-0.01 (0.63)	-1.21 (0.91)	1.87 (1.44)	-2.88 (1.19)	-2.20 (1.68)	1.96 (1.95)	-1.29 (1.12)	0.32 (2.25)	1.21 (1.65)
Female white-collar	-0.94 (1.03)	0.52 (0.50)	0.30 (0.70)	0.91 (1.11)	-0.79 (0.92)	-1.11 (1.29)	0.62 (1.51)	1.45 (0.90)	-0.85 (1.74)	-0.11 (1.28)
Male no college	-2.72 (1.16)	-0.01 (0.54)	1.13 (0.76)	0.23 (1.21)	1.38 (0.98)	-2.21 (1.57)	3.09 (1.65)	-2.00 (1.08)	-0.38 (1.96)	1.49 (1.39)
Female no college	-0.69 (1.06)	-0.06 (0.51)	-0.33 (0.71)	-1.15 (1.13)	2.22 (0.93)	0.04 (1.38)	-0.64 (1.53)	0.79 (0.91)	-1.34 (1.79)	1.15 (1.28)
White	-3.38 (1.61)	-0.59 (0.78)	0.72 (1.19)	2.04 (1.79)	1.21 (1.54)	1.65 (2.38)	-2.61 (2.56)	-0.68 (1.71)	1.55 (3.13)	0.09 (2.40)
Home owner	-3.21 (1.39)	0.54 (0.70)	1.39 (1.02)	0.03 (1.50)	1.25 (1.28)	-4.32 (1.85)	-0.74 (2.07)	-1.24 (1.28)	2.66 (2.50)	3.63 (1.98)
Predicted probability for typical HH (%)	27.3	5.9	11.4	35.3	20.1	16.2	23.1	7.8	38.3	14.6

Note: Numbers in parenthesis are asymptotic standard errors. The coefficient is bold if we can reject the null hypothesis that the coefficient is 0 at the 0.05 level. For the refrigerated sample, the χ^2 statistic that all the coefficients are zero is 2,168, and there are 10,368 observations. For the frozen sample, the χ^2 statistic that all the coefficients are 0 is 663, and there are 4,289 observations.

Table 9: Simulation of the Effect of Changes in Sales Frequencies on Group Membership, Refrigerated and Frozen Samples

	Sales freq (%)	Refrigerated					Frozen				
		Major NBs only	PLs only	Minor NBs only or all NBs	PLs and all NBs	All brands	Major NBs only	PLs only	minor NBs only or all NBs	PLs and all NBs	All brands
Private label	0	33.49	2.03	23.08	24.20	17.20	25.72	13.79	12.28	35.83	12.38
	25	29.07	4.43	16.00	31.34	19.17	20.86	19.38	9.24	38.25	12.26
	50	23.37	8.99	10.27	37.59	19.79	16.25	26.17	6.68	39.23	11.67
	75	17.22	16.70	6.04	41.32	18.72	12.15	33.92	4.63	38.63	10.66
	100	11.49	28.11	3.22	41.14	16.04	8.74	42.26	3.09	36.56	9.36
Refrig. major national brands or frozen Minute Maid	0	20.56	17.49	8.06	45.49	8.41	18.65	22.53	8.14	38.04	12.63
	25	23.00	12.79	9.72	42.72	11.78	19.89	20.68	8.68	38.58	12.18
	50	24.88	9.04	11.33	38.79	15.95	21.14	18.92	9.22	39.00	11.72
	75	26.04	6.19	12.78	34.08	20.91	22.40	17.26	9.78	39.32	11.24
	100	26.40	4.10	13.97	29.00	26.54	23.68	15.70	10.33	39.54	10.75
Minor national brands	0	44.79	7.63	16.62	12.11	18.85	18.42	29.78	3.91	40.13	7.77
	25	27.42	6.46	10.39	37.63	18.10	19.93	20.04	9.17	38.32	12.54
	50	22.21	7.24	17.83	29.73	22.99	19.01	11.89	18.99	32.26	17.85
	75	16.45	7.43	27.95	21.47	26.70	15.49	6.02	33.59	23.20	21.70
	100	11.06	6.91	39.78	14.08	28.16	10.68	2.58	50.29	14.12	22.33

Result 10: More frequent sales of frozen products other than Minute Maid raises the probability that a household is loyal to frozen products or switches between types. In contrast, more frequent sales of refrigerated products raises loyalty to refrigerated produces and discourages switching across types.

7. Conclusions

We use two models to analyze the effects of more frequent sales on consumers' buying behavior. In one model, we explain brand shares as a function of sales frequency and demographic characteristics. In the other, we show that loyalty or switching behavior also vary with sales frequency and demographic characteristics.

Table 10: Marginal Effects on Group Membership, Combined Sample

	<i>Refrigerated only</i>	<i>Frozen only</i>	<i>Across types</i>
<i>Sales frequency</i> (% of weeks)			
Frozen private label	-0.161 (0.030)	0.051 (0.018)	0.110 (0.028)
Frozen Minute Maid	0.032 (0.023)	-0.029 (0.015)	-0.002 (0.022)
Frozen minor national brands	-0.387 (0.028)	0.119 (0.018)	0.268 (0.026)
Refrigerated private label	0.281 (0.024)	-0.186 (0.018)	-0.095 (0.022)
Refrigerated major national brands	0.265 (0.028)	-0.052 (0.016)	-0.214 (0.026)
Refrigerated minor national brands	0.120 (0.427)	-0.099 (0.015)	-0.022 (0.022)
Household Size	-2.643 (0.027)	-0.222 (0.253)	2.865 (0.402)
Household's annual income (\$ thousands)	0.195 3.548)	-0.089 (0.016)	-0.106 (0.025)
Household income > \$100,000	19.598 (1.910)	-9.014 (2.269)	-10.584 (3.365)
Presence of kids under 6	-5.680 (1.389)	2.512 (1.062)	3.169 (1.756)
Male full time employed	0.325 (0.985)	0.247 (0.820)	-0.571 (1.311)
Female full time employed	-0.553 (1.331)	0.360 (0.786)	0.193 (0.928)
Male white-collar	-2.237 (1.331)	1.168 (0.601)	1.068 (1.251)
Female white-collar	3.647 (1.031)	-1.410 (0.601)	-2.237 (0.970)
Male no college	3.93 (1.134)	-1.650 (0.682)	-2.285 (1.074)
Female no college	6.843 (1.063)	-3.151 (0.638)	-3.692 (1.003)
White	-7.570 (1.737)	4.158 (1.136)	3.411 (1.643)
Home owner	-4.761 (1.425)	3.477 (0.890)	1.284 (1.342)
Predicted probability for a typical HH (%)	56.1	33.6	33.6

Note: Numbers in parenthesis are asymptotic standard errors. The coefficient is bold if we can reject the null hypothesis that the coefficient is zero at the 0.05 level. The χ^2 statistic that all the coefficients are zero is 863, and there are 12,578 observations.

Table 11: Simulation of the Effect of Changes in Sales Frequencies on Group Membership, Combined Sample

<i>Categories</i>	<i>Sales frequency (%)</i>	<i>Refrigerated only</i>	<i>Frozen only</i>	<i>Across-type</i>
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Frozen private label	0	56.08	11.24	32.67
	25	52.04	12.74	35.22
	50	47.95	14.34	37.71
	75	43.88	16.03	40.09
	100	39.88	17.79	42.33
Frozen Minute Maid	0	49.91	14.19	35.90
	25	51.06	13.13	35.81
	50	52.17	12.14	35.69
	75	53.25	11.22	35.53
	100	54.31	10.35	35.34
Frozen minor national brands	0	59.70	10.13	30.18
	25	49.79	13.58	36.63
	50	39.86	17.48	42.66
	75	30.65	21.62	47.73
	100	22.73	25.78	51.50
Refrigerated private label	0	38.90	24.07	37.03
	25	47.00	16.37	36.64
	50	54.52	10.68	34.80
	75	61.25	6.75	32.00
	100	67.12	4.16	28.71
Refrigerated major national brands	0	33.40	16.97	49.63
	25	39.61	15.68	44.72
	50	46.17	14.23	39.59
	75	52.87	12.69	34.44
	100	59.46	11.12	29.42
Refrigerated minor national brands	0	46.54	17.55	35.92
	25	50.12	14.00	35.88
	50	53.44	11.06	35.50
	75	56.51	8.66	34.83
	100	59.34	6.74	33.93

The frequency of sales affects the share of consumers that buy a particular brand and the loyalty of consumers to that brand. We find that, as the sales frequency increases for a given brand, households are more likely to be loyal to that brand or switch between that brand and others and less likely to be loyal to other brands. These results conflict with the implicit assumption of many of the best-known theoretical industrial organization models that loyalty is exogenously determined and independent of sales frequency.

Some manufacturers believe and some theoretical models contend that sales should have a greater effect the more durable (and hence storable) is a good. Although the effects of sales between refrigerated and frozen orange juice are not identical, we did not find strong evidence that increased sales frequency has a greater effect on brand share or loyalty for frozen rather than refrigerated orange juice. However, we did find some puzzling effects of sales frequency for Minute Maid, the leading frozen brand. In addition, we found that more frequent sales of frozen products (other than Minute Maid) raises the probability that a household is loyal to frozen products or switches between types; whereas, more frequent sales of refrigerated products raises loyalty to refrigerated products and discourages switching across types.

Some theoretical models also require that a store be able to identify switchers, which our results suggest is difficult because, few observable consumer characteristics other than family size and income have statistically significant effects much less economically significant effects. As household income rises, consumers are more likely to be loyal to a national brand, less likely to be loyal to a private label, and less likely to switch. Larger households are more likely to buy a private label. More frequent sales of frozen products other than Minute Maid raise the probability that a household is loyal to frozen products or switches between types. In contrast, more frequent sales of refrigerated products raise loyalty to refrigerated products and discourage switching across types.

We also found some interesting characteristics of sales and loyalty. Switching behavior is extremely common and brand loyalty is relatively uncommon for orange juice. The share of consumers who remain loyal to a brand drops substantially as the period studied increases. Refrigerated orange juice consumers are more likely to be loyal to a major brand than are frozen orange juice customers. Refrigerated major national brands are on sale much more frequently than other brands of either type products. Contrary to popular perception, private label products are on sale as frequently as many national brands.

Perhaps our most unusual result, which has not been discussed in either theoretical or empirical papers, is that consumers are very willing to switch between frozen and refrigerated orange juice. By failing to notice these more complicated substitution patterns across types of products, firms and researchers may conclude that consumers are more brand loyal than is actually true.

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