Marketing-Management Impacts on Produce Sales

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Produce departments are important to the profitability and competitiveness of grocery stores. Understanding how variables beyond price and seasonality impact the demand and ultimately sales for produce is vital. This study finds display size and the use of multiple displays to be the most powerful tools (after price) that produce managers have available to them, but only with the right products. Also, point-of-purchase signage is found to have limited impact. These findings are based on the estimation of a demand system of fruits with prices, advertising size and location, display size (including multiple displays), and product origin among the explanatory variables.

The quality and type of product in the produce department can be a major factor that attracts customers to a store (Cook 1990), and over the past decade the produce department has become a larger contributor to the overall profitability of grocery stores and supermarkets (Berner 1999; Perosio et al. 2001; Richards 2000; Schaffner 2002). Without a doubt, the produce department is a significant component in the grocery retail industry, and thus the management and marketing of this department is important. Produce managers are responsible for making and implementing different marketing decisions for products within the produce department. These decisions include pricing, display sizes, point-of-purchase (POP) material, information on the characteristics of the product, information on where a product was produced, and the product display itself. With the expectation that the average produce department will carry over 400 different items by 2006 (Perosio et al. 2001; Schaffner 2002), it has become vital to determine how different marketing practices affect the profitability of the produce department. Examining how these marketing decisions affect the demand for produce will provide an insight into how those decisions are affecting sales volume and profitability of produce departments.

This study measures the impact of marketing strategies used by produce managers on consumer purchasing behavior. Previous research using a classic demand structure has shown prices, advertisements, and income levels have an impact on demand. In a traditional retail environment, prices and advertisements are not the only factors that are influencing consumers' purchases. Factors such as product placement, display size, and product appearance can influence consumers' decisions. This study expands on classic demand models by incorporating additional factors controlled by the produce managers. Including these factors provides a more complete picture of the influences on consumer purchasing behavior for fresh fruit at the retail level.

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Literature Review

Demand analysis is not new, especially for produce. Epperson, Tyan, & Huang (1981) estimated a demand system for 16 types of fresh fruit products. More recent fruit demand analyses include You, Epperson, and Haung (1996) using national annual data; Richards (2000) at the household level; Brown and Lee (2002) at the national level; and Durham, McFetridge, and Johnson (2005) at the retail level. Traditional demand analysis includes own and cross prices, expenditures, and, where appropriate, seasonality and advertising variables. However, the broader social-science literature indicates that other factors need to be taken into consideration when evaluating consumer purchasing patterns for fresh produce. These factors include in-store promotional efforts, display arrangements in the produce section, and regional branding.

Given the vast amount of resources devoted by food firms to advertising and promotion, it is not surprising that studies continue to confirm that advertising and promotions can influence demand (Durham, McFetridge, and Johnson 2002; Richards 2000; Schmit and Kaiser 2004; Vande Kamp and

Kaiser 2000). Some demand studies account for advertising and promotions using an all-inclusive binary variable for advertisements and promotions. However, binary variables do not examine how the different aspects of advertisements or promotions impact consumer purchasing behaviors. Another way to incorporate advertising is to use advertising expenditures, which at least accounts for different levels of advertising. At certain levels of aggregation these are the only plausible advertising variables to consider. However, these methods miss the impact different types of advertising can have, and say nothing about the attributes of the advertising.

POP has been found by a number of authors to influence consumer behavior. Areni, Duhan, and Kiecker (1999) found that some POP even had negative effects (e.g. a regional winery marketing a type of wine that is known to be from another region/country). Allenby and Ginter (1995) found that advertising exhibits a significant and positive influence on the probability of choice. This effect is particularly strong for products that were featured in a store's weekly fliers, suggesting that the use of feature advertising is more effective than in-store display advertising. Soley and James (1982) found that the size and location of ads in the in-store fliers matter as well.

Price promotions, which are a separate issue from in-store flier advertisements, occur regularly. Ailawadi and Neslin (1998) and Raju (1992) found that the use of price promotions increased sales of the promoted products. There is some question as to what the consumer sees and remembers, though. Zaichkowsky and Sadlowsky (1991) looked at the accuracy of consumer awareness of advertised grocery items and found that consumers routinely underestimated the number of advertised products and the price that these products are marked down. Liefeld and Heslop (1985) found that when no reference price was given in conjunction with the sales price, the consumer cannot tell whether it is a good deal or not. This raises the question of the consumers' memory about recent promotions and how that impacts their behavior.

Researchers have found that consumers form price expectations based on historical pricing patterns (Jacobson and Obermiller 1990; Kalwani and Yim 1990, 1992; Krishna 1991, 1994; Krishna, Currim, and Shoemaker 1991; Kyong-Nan and Schumann 2001; Mazumdar, Raj, and Sinha 2005; Mela and Urbany 1997). However, these studies often examine the pricing of a durable good, not a perishable one. Richards (2000) argues that perishability does play a role in consumers' choice between fruit varieties. Therefore it is uncertain how price promotions will impact consumer behavior.

Even though brands are limited in the produce section (Richards 2000), Nowlis and Simonson (1996) found that products that lack features or brand recognition relative to other products gain more from the introduction of a new accessory. This may help explain why studies (Brooker, Eastwood, and Orr 1987; Brumfield, Adelaja, and Lininger 1993), found that promoting the location of origin, especially for local product, will benefit sales of produce. Fruit varieties therefore could have a brand-like impact, as could regional affiliation of the product (e.g., Washington apples).

In addition to advertising and promotion, factors related to produce department layout can be important. For example, Inman and Winer (1998) argue that display location is now a strategic tool (as opposed to a short-term tactical solution). Studies have examined the impact of display locations including end aisles and free-standing displays (Allenby and Ginter 1995; Epperson, Tyan, and Huang 1981; Gagnon and Osterhaus 1985; Landry 1996; Lemon and Nowlis 2002). The basic idea is that different product placements will lead to different probabilities of consumers observing the product. What isn't considered in these studies is the impact of size of the display.

Quality (e.g., bruising, ripeness) of produce should have an impact on demand (Bronnenberg and Wathieu 1996; Brumfield, Adelaja, and Lininger 1993; Cook 1990; Lemon and Nowlis 2002). Durham, McFetridge, and Johnson (2002) included a quality variable in their study based on in-store observations. However, due to the limited ability to continuously observe quality, it is very difficult to adequately include a measure of quality in an estimated model (Durham, McFetridge, and Johnson 2005).

Seasonality is important for many food products, and food-demand studies continue to account for seasonal effects (Arnade and Pick 2000; Epperson, Tyan, and Huang 1981; Winfree et al. 2004). Specifically, Nayga (1995) finds that weekly household expenditures on fresh fruit are higher in the second and third quarters than in the fourth quarter of the

year. Seasonality must also be accounted for, given that fresh, un-stored products are particularly favored in fruits and some produce types and varieties are not in the produce department year-round (Beamer and Preston 1993). Fresh fruit and vegetable consumption is much more seasonal than that of other foods (Herrmann and Roeder 1998)

This body of literature indicates that many factors beyond prices and shares should be considered when measuring consumer demand at the retail level in a system of equations. Equation 1 represents an idealistic list of explanatory variables:

$$(1)\quad \text{SFruit}_i = f\left\{\begin{array}{l}\text{own \& cross prices}\\ \text{share expenditure}\\ \text{in-store flier ad size}\\ \text{in-store flier ad placement}\\ \text{POP signage size}\\ \text{lag effect of price promotions}\\ \text{location of origin}\\ \text{display size}\\ \text{display location}\\ \text{produce quality}\\ \text{seasonality}\end{array}\right\},$$

where SFruit_i is the share of fruit sales for fruit type *i*. The explanatory variables include the traditional prices of the fruit type and its substitutes, as well as share expenditures (the share of the fruit budget spent on that fruit type). In addition to these variables, we include the size of ads in the store's weekly fliers and the placement of these ads (e.g., front or back pages), the size of POP signage, the location of origin (e.g., Washington, USA, international), the physical size of display and its location within the aisles, the quality of the produce, and seasonality. Due to the limited ability to continually observe and measure produce quality in the store, that variable is not considered in the measured model. Display location is also omitted from the model due to limited variation from week to week in produce-area arrangement. To the degree possible, the other factors in the list are accounted for.

Methodology and Data

This study follows from classical demand models, using own and substitute prices as well as expenditures. Analysis at the store level allows for other variables to be incorporated. These variables include display sizes and location, product origin identification, in-store flier ad size and location, seasonality, price promotion's residual effect, and point-of-purchase signage sizes.

To estimate demand for apples, bananas, pears, oranges, grapes and other hand fruit, the linear approximation of the Almost Ideal Demand System (AIDS) was used (Deaton and Muellbauer 1980). The AIDS is widely used in demand estimation and its details will not be reiterated here. The model is estimated as a system of share equations with one dropped to avoid singularity. The form of the share equations for the linear approximation of the AIDS model is

$$(2)\quad w_i = \alpha_i + \sum_j \gamma_{ij} \log p_i + \beta_i \log\{E/P\},$$

where w_i is the sales share of the ith good, α_i is an intercept, γ_{ij} is an estimated parameter, the $\log p_i$ are logged (standardized) prices of the goods in the system, and E/P is total group expenditure divided by the "corrected" Stone Price index (Moschini 1995).[1] As a flexible form, the AIDS satisfies the axioms of consumer preference: reflexivity, completeness, transitivity, and continuity. Since the budget shares sum to one, a share equation must be omitted to avoid a singular covariance matrix in the econometric estimation. The model is simple to estimate, and the restrictions of homogeneity and symmetry can be imposed and/or tested. The property of adding-up is not imposed but it allows the parameter estimates of the equation omitted to be recovered. The model was estimated using SAS (v. 9.0) procedure SYSLIN using the iterated seemingly unrelated regression specification with homogeneity and symmetry imposed through parameter restrictions.

In many analyses the basic system of price and expenditure is augmented with variables expected to influence consumer demand. These may enter as expansions of the intercept or be more fully integrated to allow price and expenditure elasticities to vary with them. In this study, because of the large number of variables, only the simpler augmentation of the intercept known as translating is used. In this case the intercept is replaced with $\alpha_{i0} + \sum_{k=1}^{K} \alpha_{ik} x_{ik}$,

[1] The corrected Stone Price Index is entered as $\log E - \log P$ with $\log P^* = \sum w_i \log(p_i / p_{i0})$, and the p_{i0} used is the mean value of p_i.

where the x_{ik} are the added explanatory variables and the α_{ik} are parameter estimates for those.

As discussed in the literature review, the most commonly added variables in food-demand systems are for seasonality, demographics, and/or advertising and promotion. In this study a broad selection of promotional and retail-display variables have been added. While these are selected for their value in understanding the retail-demand environment, there are limits to the number of variables that can be added if the system is to be estimated. In this analysis primary and secondary display size variables are included as explanatory variables. Using a fully balanced set of just one display variable would add eleven explanatory variables to each equation. For this reason, only the retailing variables for that product are added to each share equation.[2]

The data for this study were weekly purchases from two retail grocery stores within the same chain in the Portland, Oregon metropolitan area. The stores had different management styles and were located in different demographic areas. Weekly store visits were made to record prices, location of product origin, labeling, fruit sizes, display sizes (each product could be displayed in multiple locations), size of POP signage and corresponding sensory-wording data on apples, bananas, pears, oranges, grapes and other hand fruit.[3] Display locations were mapped and pictures of the produce area were taken on a weekly basis. Printouts containing data on total revenue and aggregated weekly quantity sold organized by product look-up (PLU) numbers were collected from the produce managers or other personnel within the store.

Weekly availability of Gala, large Fuji, large Red Delicious, and Granny Smith apples permitted them to be analyzed in individual share equations. However, other varieties of apples and pears only appear for part of the year and needed to be aggregated to produce a continual data series for share equations. The other apple varieties that appeared from week to week were aggregated based on industry descriptions into either an "other sweet apples"[4] share equation or an "other tart apples"[5] share equation. Pears, bananas, oranges, grapes and other hand fruits[6] also had share equations. The price for the aggregated products was a weighted average price.

Using the linear approximate AIDS, own and cross price elasticities can be calculated as

$$(3)\quad \eta_{ij} = -\delta_{ij} + \frac{\gamma_{ij}}{w_i} - \frac{\beta_i w_j}{w_i} \quad \forall \; i = 1, 2, \ldots, n,$$

where $\delta_{ij} = 1$ if i = j and zero otherwise; all other variables and parameters are as previously defined. The expenditure elasticities are calculated as

$$(4)\quad \phi_i = \frac{\beta_i}{w_i} + 1.$$

Elasticities for continuous augmenting variables are calculated as

$$(5)\quad \eta_{ik} = \frac{\alpha_{kj}}{w_i}\left(1 - \beta_i \ln p_i\right) \; \forall \; k = 1, 2, \ldots, k.$$

Results

The demand system included an equation for Gala, Fuji, Red Delicious, Granny Smith, Other Tart Apples, and Other Sweet Apples, as well as for oranges, grapes, bananas and other hand fruit. Summary statistics by equation for each non-dummy explanatory variable can be found in Table 1a, and the proportions of non-zeros for dummy variables are presented in Table 1b.

The results for the demand-system estimation are very good. The overall system R^2 is 0.6884 and the initial OLS adjusted R^2 for each equation is equally respectable (Table 2). Homogeneity holds in seven

[2] This decision means that the adding-up condition for these other variables cannot be applied to retrieve the parameters for the omitted "other fruit" equation, and that the parameter estimates can vary based on which equation is omitted. In the analysis, various equations were systematically omitted and the variation in estimates was minor.

[3] "Other hand fruit" is the type of fruit people can eat with little preparation, similar to apples. Other hand fruit includes kiwis, peaches, plums, bagged fruit, and organic fruit.

[4] Other sweet apples included Golden Delicious, Cameo, Jonagold, Small Red Delicious, Small Fuji, Pacific Rose, Honey Crisp, Sonata, and Queen apples.

[5] Tart apples included Braeburn, Pink Lady, McIntosh, Southern Rose, and Pippin apples.

[6] The "other hand fruit" equation was excluded from the model to ensure that the data matrix would be non-singular.

Table 1a. Summary Statistics for Explanatory Variables by Equation.

Variable	Mean	Std. dev.	Minimum	Maximum	Range
Prices (not logged)					
Gala	1.11	0.42	0.33	1.99	1.66
Fuji	1.18	0.45	0.39	1.99	1.60
Red Delicious	0.97	0.22	0.39	1.39	1.00
Granny Smith	1.16	0.34	0.49	1.99	1.50
Other Sweet Apples	1.05	0.29	0.3	1.72	1.41
Other Tart Apples	1.32	0.3	0.39	1.89	1.50
Pears	0.97	0.25	0.37	1.72	1.36
Bananas	0.62	0.19	0.25	0.99	0.74
Oranges	0.76	0.4	0.19	2.45	2.26
Grapes	2.03	0.72	0.58	3.99	3.41
Other Fruits	1.43	0.3	0.67	2.65	1.98
Display 1 (1000s of square inches)					
Gala	2.14	1.78	0.00	8.70	8.70
Fuji	1.41	0.61	0.35	2.43	2.43
Red Delicious	0.75	0.29	0.35	1.29	1.29
Granny Smith	0.75	0.32	0.31	2.58	2.58
Other Sweet Apples	3.04	1.69	0.45	9.15	9.15
Other Tart Apples	1.36	0.45	0.45	2.94	2.94
Pears	3.60	1.74	0.66	9.12	9.12
Bananas	2.41	0.29	1.16	3.04	3.04
Oranges	5.74	3.18	0.53	20.16	20.16
Grapes	2.35	1.52	0.70	8.64	8.64
Display 2&3 (1000s of square inches)					
Gala	0.94	2.45	0.00	16.20	16.20
Fuji	0.76	1.23	0.00	7.68	7.68
Red Delicious	0.13	0.57	0.00	4.28	4.28
Granny Smith	0.06	0.35	0.00	2.21	2.21
Other Sweet Apples	0.68	1.42	0.00	7.01	7.01
Other Tart Apples	0.33	0.96	0.00	3.84	3.84
Pears	0.52	1.20	0.00	6.63	6.63
Bananas	0.01	0.08	0.00	0.90	0.90
Oranges	1.11	2.56	0.00	15.96	15.96
Grapes	0.06	0.31	0.00	2.66	2.66

Table 1a. Summary Statistics for Explanatory Variables by Equation (Continued).

Variable	Mean	Std. dev.	Minimum	Maximum	Range
Log Average POP (from square inches)					
Gala	4.29	0.93	0.00	6.46	6.46
Fuji	4.20	0.82	2.48	5.64	5.64
Red Delicious	3.46	0.88	2.48	5.95	5.95
Granny Smith	3.56	0.95	2.48	5.44	5.44
Other Sweet Apples	3.85	0.91	2.48	5.95	5.95
Other Tart Apples	3.46	0.94	2.48	5.43	5.43
Pears	4.18	0.57	2.48	5.61	5.61
Bananas	4.55	0.66	4.05	7.24	7.24
Oranges	4.58	0.64	2.48	6.19	6.19
Grapes	3.72	0.87	2.30	5.07	5.07
Front ad size (square inches)					
Bananas	2.42	5.67	0.00	24.38	24.38
Grapes	1.83	5.21	0.00	31.22	31.22
Back ad size (square inches)					
Gala	1.06	4.79	0.00	40.38	40.38
Fuji	0.65	2.38	0.00	16.00	16.00
Red Delicious	1.68	5.87	0.00	40.38	40.38
Granny Smith	1.25	4.95	0.00	40.38	40.38
Other Sweet Apples	0.47	1.65	0.00	18.38	18.38
Other Tart Apples	0.17	0.73	0.00	5.33	5.33
Pears	0.18	0.59	0.00	5.27	5.27
Bananas	1.70	5.20	0.00	33.13	33.13
Oranges	0.77	2.57	0.00	20.25	20.25
Grapes	1.16	3.39	0.00	21.00	21.00

Table 1b. Proportion of Dummy Variables Non-Zero.

Variable	International	Northwest	Lag low price	Bag availability
Gala	0.13	0.08		0.53
Fuji	0.11	0.34		0.39
Red Delicious		0.37		0.43
Granny Smith		0.37		0.51
Other Sweet Apples		0.52		0.13
Other Tart Apples	0.19	0.32		0.06
Pears	0.06	0.06		
Bananas	0.37		0.21	
Oranges	0.07		0.16	
Grapes	0.37		0.13	0.49

Table 2. OLS Share Equation Adjusted R^2 and Estimated Coefficients for Intercept, Seasons, Store and Expenditure.

	OLS Adj. R^2	Intercept		Fall		Winter		Spring		Store 3		log E/P	
Gala	0.781	0.0680	**	-0.0119	**	-0.0154	**	-0.0106	**	-0.0131	**	-0.0066	**
		(0.0291)		(0.0034)		(0.0034)		(0.0030)		(0.0028)		(0.0030)	
Fuji	0.623	0.4602	**	0.0011		-0.0024		-0.0017		-0.0014		-0.0456	**
		(0.0532)		(0.0059)		(0.0059)		(0.0057)		(0.0045)		(0.0057)	
Red Delicious	0.725	0.0708	**	0.0045	**	0.0014		0.0030	**	-0.0117	**	-0.0064	**
		(0.0114)		(0.0015)		(0.0014)		(0.0012)		(0.0010)		(0.0012)	
Granny Smith	0.470	0.0862	**	0.0075	**	-0.0003		0.0020		0.0040	*	-0.0075	**
		(0.0175)		(0.0023)		(0.0022)		(0.0019)		(0.0022)		(0.0018)	
Other Sweet Apples	0.764	0.2615	**	0.0299	**	0.0039		0.0005		-0.0060		-0.0268	**
		(0.0461)		(0.0057)		(0.0052)		(0.0050)		(0.0044)		(0.0048)	
Other Tart Apples	0.543	0.1027	**	-0.0074	**	-0.0057	**	-0.0057	**	0.0026		-0.0098	**
		(0.0232)		(0.0025)		(0.0026)		(0.0024)		(0.0020)		(0.0024)	
Pear	0.831	0.3124	**	0.0085	*	-0.0051		-0.0072	*	0.0050	*	-0.0319	**
		(0.0367)		(0.0046)		(0.0044)		(0.0039)		(0.0026)		(0.0038)	
Banana	0.618	1.1538	**	0.0174	**	-0.0017		0.0218	**	-0.0381	**	-0.1037	**
		(0.0834)		(0.0078)		(0.0080)		(0.0079)		(0.0054)		(0.0085)	
Orange	0.446	0.3677	**	0.0255	**	0.0529	**	0.0521	**	-0.0118	**	-0.0320	**
		(0.0737)		(0.0072)		(0.0080)		(0.0074)		(0.0057)		(0.0079)	
Grape	0.638	0.2107	**	0.0129		0.0060		-0.0005		0.0033		-0.0184	**
		(0.0863)		(0.0090)		(0.0104)		(0.0098)		(0.0085)		(0.0090)	

**Statistically significant at the 0.05 level, * at 0.10, and ~ at 0.15. Standard errors are in parenthesis.

of ten equations. Tests of symmetry restrictions were rejected at the five-percent level in 12 of 42 pairs (28 percent of the pairs) but only in four at the one-percent level. Results presented are with symmetry and homogeneity imposed. The variables of seasonality and store (dummy variable to account for store differences) behave as expected, as do the intercept coefficients.

Further evidence of a well-specified system of equations is the findings for the calculated elasticities for price and expenditure variables. The elasticities were calculated with Equations 3 and 4 using the mean shares and prices with the coefficients estimated in the model (Table 3) as shown in Equation 2 as needed. These elasticities (Table 4) conform to expectations of demand-system theory. Own-price elasticities are negative and most of the cross-price elasticities are positive, indicating substitute products. The estimated expenditure elasticities are also in line with demand theory (Table 4).

Given that the estimated demand model is well-behaved, the remainder of this section will focus on the marketing-management-related variables. The estimated coefficients for the marketing-management variables are presented in Table 5. The size of display was split into two groups to account for the effect of multiple displays as well as the size of the presentation to the customer. Display1 is the size, in 1000s of square inches, of the primary display as determined by surface area. Display2&3 is the sum of any additional displays of the same variety. "Log Average POP Size" is the natural log of the POP signage, measured in square inches, associated with a specific display (e.g., sign saying "Hood River Pears"). "Ad Size Front" and "Ad Size Back" are the size in square inches of ads that appeared on the front or back page of the in-store flier, respectively. International and Northwest are two location-of-origin variables that were tracked. "Lag Low Price" is the variable to account for impacts from a deep price discount the previous week.[7] Finally, "Bag Available" accounts for whether a bag of the same variety was also offered for sale in the produce section.

The estimated coefficients for Display1 are significant for Gala, Fuji, Other Sweet Apples, Other Tart Apples, Pear, and Grape equations, and all of these six coefficients are positive. The typical effect from the primary display size is an increase in share of about 0.005 per thousand square inches. To put this in perspective, the display for a single apple variety is between 745 and 2100 square inches. In the stores examined a single primary display for a varietal could drop as low as 310 square inches. Because typical variations in display size are often on the order of 100%, consideration of elasticities is meaningless, as it would be quite small.[8] Suffice it to say that changes in display size generally have a sizable, positive impact on sales share.

Occasionally, a product is presented in two or even three locations, the idea being that the more offerings there are of a product, the more likely it is that people will observe and buy it. This is supported by the Display2&3 estimated coefficients. They are significant for every equation except bananas and oranges. For bananas and oranges, the lack of secondary-display-size impact coincides with lower price elasticities and greater overall primary display space. The sign of Display2&3 is positive for each of the estimated coefficients except for grapes. One possible explanation for this effect on grapes is the popularity of grapes with children, making them highly sought after by parents. Thus the primary display gets prime real estate in the produce area and the secondary display is in a less desirable location. In any case, grapes are the only fruit variety where it is a disadvantage to be split into two displays.

In comparing the impact of Display1 versus Display2&3, the more price-elastic products have greater payoffs from changes in primary display space (e.g., Gala, Fuji, Red Delicious, Other Sweet Apples, and Other Tart Apples) versus offering multiple displays. But increasing the number of displays for products that are closer to being unitary elastic (e.g., price elasticity is equal to 1.0) produces a larger impact on demand than do changes in Display1. Price-inelastic products, on the other hand, could have less space devoted to them than they currently enjoy because customers will seek them out (e.g., bananas are not significantly impacted by changes in either Display1 or Display2&3). Thus

[7] Deep price discounts were limited to bananas, oranges, and grapes.

[8] Given these large variations in values, elasticities for Display1 for Gala apples, for example, would be only 0.033, and of course a one-percent change in display size would not be discernable to consumers and is less than our square-inch measure would capture.

Table 3. Estimated Price Coefficients.

Share Equation	Gala		Fuji		Red Delicious		Granny Smith		Sweet Apples		Tart Apples	
Gala	-0.0369	**	0.0087	**	0.0039	**	0.0026	~	0.0105	**	0.0064	**
	(0.0034)		(0.0024)		(0.0011)		(0.0016)		(0.0025)		(0.0020)	
Fuji	0.0087	**	-0.0505	**	0.0045	**	0.0030	*	0.0118	**	0.0054	**
	(0.0024)		(0.0055)		(0.0010)		(0.0015)		(0.0034)		(0.0020)	
Red Delicious	0.0039	**	0.0045	**	-0.0154	**	0.0027	**	0.0033	**	0.0037	**
	(0.0011)		(0.0010)		(0.0017)		(0.0014)		(0.0012)		(0.0012)	
Granny Smith	0.0026	~	0.0030	*	0.0027	**	-0.0028		0.0006		0.0002	
	(0.0016)		(0.0015)		(0.0014)		(0.0028)		(0.0017)		(0.0017)	
Other Sweet Apples	0.0105	**	0.0118	**	0.0033	**	0.0006		-0.0529	**	0.0020	
	(0.0025)		(0.0034)		(0.0012)		(0.0017)		(0.0046)		(0.0021)	
Other Tart Apples	0.0064	**	0.0054	**	0.0037	**	0.0002		0.0020		-0.0271	**
	(0.0020)		(0.0020)		(0.0012)		(0.0017)		(0.0021)		(0.0030)	
Pear	-0.0109	**	-0.0027		-0.0002		-0.0006		0.0065	**	-0.0003	
	(0.0027)		(0.0029)		(0.0013)		(0.0020)		(0.0031)		(0.0024)	
Banana	0.0000		0.0028		0.0001		-0.0010		0.0066	**	0.0025	~
	(0.0020)		(0.0032)		(0.0008)		(0.0012)		(0.0029)		(0.0016)	
Orange	0.0034	*	0.0018		0.0006		-0.0038	**	0.0020		0.0052	**
	(0.0018)		(0.0033)		(0.0007)		(0.0012)		(0.0028)		(0.0015)	
Grape	0.0063	**	0.0080	**	0.0009		0.0003		0.0081	**	0.0035	**
	(0.0021)		(0.0034)		(0.0008)		(0.0012)		(0.0030)		(0.0016)	

**Statistically signifcant at the 0.05 level, * at 0.10, and ~ at 0.15. Standard errors are in parenthesis.

Table 3. Estimated Price Coefficients (Continued).

Share Equation	Pear		Banana		Orange		Grape		Other Fruit	
Gala	-0.0109	**	0.0000		0.00304	*	0.0063	**	0.0085	**
	(0.0027)		(0.0020)		(0.0018)		(0.0021)		(0.0032)	
Fuji	-0.0027		0.0028		0.0018		0.0080	**	0.0102	*
	(0.0029)		(0.0032)		(0.0033)		(0.0034)		(0.0062)	
Red Delicious	-0.0002		0.0001		0.0006		0.0009		-0.0014	
	(0.0013)		(0.0008)		(0.0007)		(0.0008)		(0.0013)	
Granny Smith	-0.0006		-0.0010		-0.0038	**	0.0003		-0.0040	**
	(0.0020)		(0.0012)		(0.0012)		(0.0012)		(0.0020)	
Other Sweet Apples	0.0065	**	0.0066	**	0.0020		0.0081	**	0.0020	
	(0.0031)		(0.0029)		(0.0028)		(0.0030)		(0.0049)	
Other Tart Apples	-0.0003		0.0025	~	0.0052	**	0.0035	**	-0.0012	
	(0.0024)		(0.0016)		(0.0015)		(0.0016)		(0.0025)	
Pear	-0.0198	**	0.0061	**	0.0026		0.0094	**	0.0093	**
	(0.0043)		(0.0026)		(0.0024)		(0.0027)		(0.0040)	
Banana	-0.0268	**	0.0291	**	-0.0067	*	0.0050		-0.0126	~
	(0.0088)		(0.0072)		(0.0038)		(0.0043)		(0.0084)	
Orange	0.0063		-0.0067	*	-0.0353	**	0.0172	**	0.0055	
	(0.0087)		(0.0038)		(0.0060)		(0.0040)		(0.0076)	
Grape	-0.0031		0.0050		0.0172	**	-0.0679	**	0.0219	**
	(0.0097)		(0.0043)		(0.0040)		(0.0085)		(0.0093)	

**Statistically signifcant at the 0.05 level, * at 0.10, and ~ at 0.15. Standard errors are in parenthesis.

Table 4. Price and Expenditure Elasticities.

	Price Elasticities (Own in Bold)										
Share equation	Gala	Fuji	Red Delicious	Granny Smith	Other Sweet Apples	Other Tart Apples	Pear	Bananas	Oranges	Grapes	Expenditure elasticity
Gala	**-2.4166**	0.3522	0.1559	0.1045	0.4195	0.2535	-0.4067	0.0541	0.1562	0.2780	0.7438
Fuji	0.1690	**-1.8142**	0.2930	0.1659	0.2526	0.1112	-0.0037	0.2065	0.1034	0.2456	0.2235
Red Delicious	0.2463	0.2930	**-1.9218**	0.1710	0.2205	0.2315	0.0067	0.0831	0.0749	0.1085	0.6181
Granny Smith	0.1443	0.1786	0.1479	**-1.1383**	0.0516	0.0189	-0.0097	0.0272	-0.1588	0.0716	0.6116
Other Sweet Apples	0.2107	0.2526	0.0712	0.0214	**-1.9604**	0.0511	0.1504	0.2347	0.0878	0.2281	0.4624
Other Tart Apples	0.2571	0.2289	0.1487	0.0138	0.0971	**-2.0369**	0.0091	0.1726	0.2357	0.1896	0.6224
Pear	-0.1860	-0.0150	0.0055	0.0004	0.1511	0.0098	**-1.3328**	0.2335	0.1031	0.2561	0.4121
Bananas	0.0133	0.0431	0.0088	0.0048	0.0593	0.0250	-0.1034	**-0.7545**	0.0150	0.0956	0.4952
Oranges	0.0449	0.0384	0.0124	-0.0332	0.0389	0.0634	0.0854	-0.0016	**-1.3413**	0.2298	0.6616
Grapes	0.0479	0.0644	0.0086	0.0048	0.0647	0.0284	-0.0147	0.0624	0.1347	**-1.4636**	0.8698

produce managers should allocate space and decide which products get multiple displays based on the price elasticity of each product.

The size of POP signage rarely has a significant impact (only for the Gala, Red Delicious, and Grape equations), though it is positive as expected when it is significant. In this study, produce managers had adopted standardized signs over the study period and the size of POP signs stabilized. This stabilization, or reduction of variability, reduces the ability of the estimation to detect an impact of signage. This is one possible explanation for the limited number of significant estimated coefficients.

The promotional options produce managers have at their disposal include highlighting products in the store's weekly flier or circular. The size of the ad and the placement in the circular is accounted for with the "Ad Size-back" and "Ad Size-front" variables. The size of the ad on the back page of the flier has limited influence; only the Gala, Granny Smith, Other Sweet Apples, and Oranges equations show significant impact, and Orange and Other Sweet Apples have negative (though quite small) estimated coefficients. Due to limited observations for front page ads, only bananas and grapes have "Ad Size-front" variables, and the estimated coefficients are positive. Regardless of the level of significance or sign, the overall impact on shares of fruits should be considered in terms of typical ad size versus no ad. For example, the typical Gala share averages 0.026. If a four-inch-by-four-inch ad for Gala Apples was added to the flyer, a share increase of 0.007 (= 0.00045*16) would be expected. This is about a 28 percent increase in the product share.

Product-origin variables had mixed results. The International variable, a dummy variable denoting that the item is labeled as a product from another country, is only significant in the case of pears and oranges, having a negative effect on the share of pears and a positive effect on the share of oranges. Because both of these fruits are aggregates of multiple varieties, the dummy variable was calculated by weighting sub-variety dummy variables by the display share of that sub-variety. This weighted dummy variable may be influencing results, particularly for oranges. The Northwest dummy variable, a variable indicating origins in Washington or Oregon, is similarly weighted for aggregations in the other sweet apple and other tart apple groups. Results indicate that Northwest origin has a negative effect on the sweet apples but a positive effect on the disaggregated apple varieties.

The "Lag Low Price" variable is a dummy variable representing when a deeply discounted price is offered in the previous week. This variable is intended to catch the effect of consumers tiring of the variety (burnout) and/or stockpiling. This variable is added only to the banana, orange, and grape equations. It is not added to the apples and pear equations because of the lack of a definitive low-price breaking point of less than half of the mode price. For the three included lagged low-price dummy variables, the break points are set less than or equal to 39 cents for bananas and oranges and less than or equal to 99 cents for grapes. The lagged low-price variable occurred in 21, 23, and 17 percent of the banana, orange, and grape observations, respectively. These deep discounts usually occur because the product is being treated as a loss leader to get the consumer into the store to buy other products. The estimated coefficients are significant and negative, indicating that the loss leader one week will experience ripple effects with lower sales the following week for these products. The gains in additional sales of other grocery items needs to be considered in order to determine the overall impact of this pricing practice, a task that is beyond the scope of this project.

Finally, the availability of like products or fruit varieties in bags (or boxes in the case of oranges), is accounted for. The effect of bagged availability was negative on the share of bulk sales when significant.

Conclusions

Beyond price, many factors significantly affect the demand by consumers for fresh produce. This study identified nine marketing-management variables that have varying degrees of influence on consumer demand for fresh fruit. Display size had a positive and significant influence on almost every variety considered, and the size of the secondary/tertiary displays generally had a similar impact. The size of point-of-purchase signage in square inches was significant in five of the ten share equations. Ads in the in-store flyer proved to be valuable as well, with the front-page placements having a larger impact than other placements. The study found pears from foreign countries to be less preferred, but foreign

Table 5. Estimated Coefficients for Marketing Management Variables.

Share Equation	Display 1		Display 2&3		Log POP		Ad size front		Ad size back	
Gala	0.0030	**	0.0007	*	0.0066	**			0.0045	**
	(0.0006)		(0.0004)		(0.0014)				(0.0017)	
Fuji	0.0167	**	0.0117	**	-0.0040	~			0.0048	
	(0.0031)		(0.0018)		(0.0024)				(0.0061)	
Red Delicious	0.0013		0.0027	**	0.0024	**			-0.0004	
	(0.0013)		(0.0006)		(0.0005)				(0.0006)	
Granny Smith	0.0023	~	0.0088	**	-0.0014				0.0021	*
	(0.0014)		(0.0013)		(0.0012)				(0.0011)	
Other Sweet Apples	0.0086	**	0.0018	*	0.0029				-0.0184	**
	(0.0009)		(0.0010)		(0.0023)				(0.0075)	
Other Tart Apples	0.0094	**	0.0034	**	0.0011				0.0036	
	(0.0015)		(0.0010)		(0.0012)				(0.0086)	
Pear	0.0086	**	0.0077	**	-0.0006				0.0601	**
	(0.0008)		(0.0010)		(0.0021)				(0.0169)	
Banana	-0.0058		-0.0022		0.0054	~	0.0202	**	-0.0041	
	(0.0071)		(0.0270)		(0.0033)		(0.0049)		(0.0039)	
Orange	0.0012	~	-0.0007		-0.0044				-0.0137	*
	(0.0008)		(0.0010)		(0.0048)				(0.0081)	
Grape	0.0079	**	-0.0262	**	0.0202	**	0.0245	**	0.0081	
	(0.0021)		(0.0084)		(0.0044)		(0.0066)		(0.0081)	

**Statistically signifcant at the 0.05 level, * at 0.10, and ~ at 0.15. Standard errors are in parenthesis.

Table 5. Estimated Coefficients for Marketing Management Variables (Continued).

Share Equation	International	Northwest	Lag low price	Bag available
Gala	0.0018	0.0107 **		-0.0020
	(0.0029)	(0.0030)		(0.0021)
Fuji	0.0064	0.0079 **		-0.0054 ~
	(0.0057)	(0.0033)		(0.0037)
Red Delicious		0.0015 *		-0.0038 **
		(0.0009)		(0.0007)
Granny Smith		0.0002		-0.0007
		(0.0010)		(0.0012)
Other Sweet Apples		-0.0089 *		-0.0027
		(0.0049)		(0.0042)
Other Tart Apples	-0.0006	0.0004		0.0034
	(0.0024)	(0.0022)		(0.0034)
Pear	-0.0186 **	0.0072		
	(0.0071)	(0.0069)		
Banana			-0.0106 **	
			(0.0051)	
Orange	0.0748 **		-0.0116 *	0.0009
	(0.0152)		(0.0062)	(0.0047)
Grape	-0.0077		-0.0193 **	
	(0.0077)		(0.0076)	

**Statistically signifcant at the 0.05 level, * at 0.10, and ~ at 0.15. Standard errors are in parenthesis.

oranges were desired more. Consumers bought a smaller share of bananas, oranges, and grapes the week after a big price discount. Finally, the offering of bagged fruit had limited but negative effects on the demand for some apple varieties.

The above results have implications for produce managers, fruit suppliers, and future research studies of this kind. First, the results indicate that produce managers have some influence on what produce consumers purchase, but not all tools have equal effect. By far, the most powerful tool (after price) is the display size and use of multiple displays. However, produce mangers need to be careful as it is sometimes better to offer two displays rather than building larger single displays. As for POP signage, these results indicate that there is little to no impact on shares. However, the limited variation in size of POP signage may be driving that result. The decision by produce managers to advertise in the store's weekly circular is a complex decision, as the increase in sales of that variety will come at the expense of another. However, once managers choose to place a product on sale, it is beneficial to push for front-page advertising space in the store's circular for the product, especially if payment is required for the space; if payment is required, a lower rate should be negotiated for a back-page ad placement.

Producers or distributors supplying the produce to stores can develop useful strategies from these results as well. For example, when negotiating the terms of the deal, consideration of display size and the number of displays may help balance pressures from the produce manager to keep prices low (e.g, make up for lower margins with higher volume of sales). Getting a spot in the in-store flyer is positive, but if the store requires the supplier to pay for the spot it may behoove the supplier to negotiate a front-page placement, depending on the price difference between a front-page versus back-page placement.

This study has attempted to account for several factors that have never been considered collectively before. This type of work comes with some limitations, as well as ideas for future research. One such result is that future research will need to look at the trade-off between making larger primary displays versus offering a second display. Whatever future researchers tackle, a greater effort should be taken to make sure the variables have sufficient variation. It is hoped that this research will influence produce manager who don't currently changing practices (e.g.: POP signage size) on a regular basis to increase variation.

References

Ailawadi, K. L. and S. A. Neslin. 1998. "The Effect of Promotion on Consumption: Buying More and Consuming It Faster." *Journal of Marketing Research* 35(3):390–398.

Allenby, G. M. and J. L. Ginter. 1995. "The Effects of in-Store Displays and Feature Advertising on Consideration Sets." *International Journal of Research in Marketing* 12(1):67–80.

Areni, C. S., D. F. Duhan, and P. Kiecker. 1999. "Point-of-Purchase Displays, Product Organization, and Branch Purchase Likelihoods." *Journal of the Academy of Marketing Science* 27(4):428.

Arnade, C., and D. Pick. 2000. "Seasonal Oligopoly Power: The Case of the Us Fresh Fruit Market." *Applied Economics* 32(8):969–977.

Beamer, B. G. and W. P. Preston. 1993. "Organizational Structures and Strategic Management of Produce Marketing in Retail Supermarkets." *Agribusiness* 9(2):103–117.

Berner, R. 1999. "A Battle Fought with Kiwis and Kale." *Wall Street Journal* (Eastern Edition): B1.

Bronnenberg, B. J. and L. Wathieu. 1996. "Asymmetric Promotion Effects and Brand Positioning." *Marketing Science* 15(4):379.

Brooker, J., D. B. Eastwood, and R. H. Orr. 1987. "Consumers' Perceptions of Locally Grown Produce at Retail Outlets." *Journal of Food Distribution Research* 18(1):99–107.

Brown, M. G., and J.-Y. Lee. 2002. "Restriction on the Effects of Preference Variables in the Rotterdam Model." *Journal of Agricultural and Applied Economics* 34(1):17–26.

Brumfield, R. G., A. O. Adelaja, and K. Lininger. 1993. "Consumer Tastes, Preferences, and Behavior in Purchasing Fresh Tomatoes." *Journal of the American Society for Horticultural Science* 118(3):433–438.

Cook, R. L. 1990. "Challenges and Opportunities in the U.S. Fresh Produce Industry." *Journal of Food Distribution Research* 21(1):67–74.

Deaton, A. and J. Muellbauer. 1980. *Economics*

and Consumer Behavior. New York: Cambridge University Press.

Durham, C. A., M. V. McFetridge, and A. J. Johnson. 2005. "The Development of a Quality Scale to Measure the Impact of Quality on Supermarket Fruit Demand." *Journal of Food Distribution Research* 36:36–41.

Durham, C. A., M. V. McFetridge, and A. J. Johnson. 2002. "In Store Demand for Eco-Labeled Fruit." Proceedings of Conference on Ecolabels and the Greening of the Food Market. Boston Massachusetts. November 7–8.

Epperson, J. E., H. L. Tyan, and C. L. Huang. 1981. "Applications of Demand Relations in the Fresh Fruit and Vegetable Industry." Journal of Food Distribution Research 12 (1):135-142.

Gagnon, J. P. and J. T. Osterhaus. 1985. "Research Note: Effectiveness of Floor Displays on the Sales of Retail Products." *Journal of Retailing* 61(1):104.

Herrmann, R. and C. Roeder. 1998. "Some Neglected Issues in Food Demand Analysis: Retail-Level Demand, Health Information and Product Quality." *Australian Journal of Agricultural & Resource Economics* 42(4):341–67.

Inman, J. J., and R. S. Winer. 1998. "Where the Rubber Meets the Road: A Model of In-Store Consumer Decision Making." Marketing Science Institute Working Paper 45.

Jacobson, R. and C. Obermiller. 1990. "The Formation of Expected Future Price: A Reference Price for Forward-Looking Consumers." *Journal of Consumer Research* 16(4):420.

Kalwani, M. U. and C. K. Yim. 1992. "Consumer Price and Promotion Expectations: An Experimental Study." *Journal of Marketing Research* 29(1):90.

Kalwani, M. U. and C. K. Yim. 1990. "A Price Expectations Model of Customer Brand Choice." *Journal of Marketing Research* 27(3):251.

Krishna, A. 1991. "Effect of Dealing Patterns on Consumer Perceptions of Deal." *Journal of Marketing Research* 28(4):441.

Krishna, A. 1994. "The Effect of Deal Knowledge on Consumer Purchase Behavior." *Journal of Marketing Research* 31(1):76.

Krishna, A., I. S. Currim, and R. W. Shoemaker. 1991. "Consumer Perceptions of Promotional Activity." *Journal of Marketing* 55(2):4.

Kyong-Nan, K. and D. W. Schumann. 2001. "The Influence of Consumers' Price Expectations on Value Perception and Purchase Intention." *Advances in Consumer Research* 28(1):316–322.

Landry, J. T. 1996. "Know Where Your Rivals Are." *Harvard Business Review* 74(6):13–13.

Lemon, K. N. and S. M. Nowlis. 2002. "Developing Synergies between Promotions and Brands in Different Price-Quality Tiers." *Journal of Marketing Research* 39(2):171.

Liefeld, J. and L. A. Heslop. 1985. "Reference Prices and Deception in Newspaper Advertising." *Journal of Consumer Research* 11(4):868.

Mazumdar, T., S. P. Raj, and I. Sinha. 2005. "Reference Price Research: Review and Propositions." *Journal of Marketing* 69(4):84–102.

Mela, C. and J. Urbany. 1997. "Promotion over Time: Exploring Expectations and Explanations." *Advances in Consumer Research* 24(1): 529–535.

Moschini, G. 1995. "Units of Measurement and the Stone Index in Demand System Estimation." *American Journal of Agricultural Economics* 77(1):63–68.

Nayga, R. M. 1995. "Determinants of U.S. Household Expenditures on Fruit and Vegetables: A Note and Update." *Journal of Agricultural and Applied Economics* 27(2):588–594.

Nowlis, S. M. and I. Simonson. 1996. "The Effect of New Product Features on Brand Choice." *Journal of Marketing Research* 33(1):36.

Perosio, D. J., E. W. McLaughlin, S. Cuellar, and K. Park. 2001. "Supply Chain Management in the Produce Industry." In *Fresh Track*. Ithaca, NY: Cornell University and Produce Marketing Association.

Raju, J. S. 1992. "The Effect of Price Promotions on Variability in Product Category Sales." *Marketing Science* 11(3):207.

Richards, T. J. 2000. "The Impact of Promotion and Advertising: A Latent Class Approach." *Journal of Agricultural and Applied Economics* 32(3): 441–457.

Schaffner, D. J. 2002. "United States Produce Markets in Transition-Today and Tomorrow." *Journal of Food Distribution Research* 33(2): 61–66.

Schmit, T. M., and H. M. Kaiser. 2004. "Decomposing the Variation in Generic Advertising Response over Time." *American Journal of Agricultural Economics* 86(1):139–153.

Soley, L. C. and W. L. James. 1982. "Estimating the Readership of Retail Newspaper Advertising." *Journal of Retailing* 58(3):59.

Vande Kamp, P. R. and H. M. Kaiser. 2000. "Optimal Temporal Policies in Fluid Milk Advertising." *American Journal of Agricultural Economics* 82(2):274–286.

Winfree, J. A., P. Gutman, R. C. Mittelhammer, and J. J. McCluskey. 2004. "Seasonal Oligopoly Power in the D'anjou Pear Industry." *Journal of Food Distribution Research* 35:56–65.

You, Z., J. E. Epperson, and C. L. Huang. 1996. "A Composite System Demand Analysis for Fresh Fruits and Vegetables in the United States." *Journal of Food Distribution Research* 27(3): 11–22.

Zaichkowsky, J. L., and D. P. Sadlowsky. 1991. "Misperceptions of Grocery Advertising." *Journal of Consumer Affairs* 25(1):98.