New Varieties and the Returns to Commodity Promotion: The Case of Fuji Apples

Timothy J. Richards and Paul M. Patterson

The Fuji apple variety is relatively new in the U.S. As a new product, questions concern the relative impact of consumer learning by experience, by variety-specific promotion, or by generic apple promotion. A two-stage (LES/LAIDS) model incorporating both types of promotion is used to estimate the effect of generic and variety specific promotion, as well as consumer experience, on the demand for Fuji apples. Estimates show each to have a positive impact, and also show new or specialty apple varieties to be relatively price inelastic, but income elastic. Grower returns to promotion are calculated with an equilibrium displacement model of price changes and producer surplus. Changes in producer surplus provide a base-scenario benefit:cost ratio of 6.33:1.

According to the Washington Apple Commission (WAC) advertising campaign slogan, 1997 was the "Year of the Fuji." Developed in Japan in 1958, growers in Washington state began growing Fujis in 1990. However, with nearly 11,000 bearing acres in 1997, Fujis became the third most popular apple in the state. Faced with marketing a product that had increased from virtually no supply at the beginning of the decade, to 3.1 million cartons in 1995–96, and to 6.9 million in 1996–97, Washington apple growers recognized the need for a Fuji-specific promotional campaign. This variety-specific focus is relatively unique among commodity promoters because, in many respects, it represents an attempt to establish a brand identity for what is usually regarded as a homogeneous commodity.

Consequently, there was some concern as to whether this campaign would be as effective as previous generic-promotion efforts (Ward 1993). Apple varieties are like brands in that they identify a subset of a product category whose members are likely to share more characteristics in common with each other than other members of the category. To the extent that variety-advertising is able to build and reinforce a favorable impression of these characteristics among consumers, then it is likely to be effective. However, there is some question of the viability of variety-specific promotion given the wide variation in quality from shipment-to-shipment. Further, like most fruits and vegetables, apples are experience goods, so purely informative promotion is not likely to be as effective as efforts designed to induce trial purchases and to build reputation (Nelson). Once consumers buy a certain type of apple, their experience and word-of-mouth may be enough to establish a market for the variety. Moreover, the relative importance of search and experience, or learning, differs between new and established varieties (Day). As a product moves along its life cycle of growth, maturity, and decline, search activities become less important than momentum built from past sales. Further, the dynamics of promotion vary with a product's stage in its life cycle. While advertising carryover from informative advertising is likely to be relatively high during early stages of the product life cycle, the decay of persuasive advertising typically used to promote mature products is more rapid. Still, if varieties are considered close substitutes by consumers, then variety-specific promotion is likely to have a cannibalistic effect on other varieties—varieties that are often grown by the same sellers of

Timothy J. Richards is an associate professor, and Paul M. Patterson is an assistant professor, both with the Morrison School of Agribusiness and Resource Management at Arizona State University. Support from the Washington Apple Commission is gratefully acknowledged.

the new variety. However, if generic promotion is effective in growing the demand for apples in total, then such synergistic or category-image effects may indeed be beneficial to growers of all varieties. As a result, growers are justifiably concerned over the economic viability of promoting Fujis through traditional techniques.

Even if promotion results in a positive response in retail demand, growers will only benefit if this increase in demand causes farm prices to rise. In general, farm prices tend to be higher for produce items that are not yet in widespread production, or if they are heavily exported. Further, retail-farm margins for various farm products have been shown to be dependent upon many other factors beyond grower control, such as quality characteristics (Parker and Zilberman), market power (Sexton 1990; Powers 1991), price rigidities (Shonkwiler and Taylor 1988; Powers 1995), or the direction of price movements (Ward 1982; Kinnucan and Forker 1987). Some or all of these factors may be important in determining the ultimate return to Fuji-apple promotion.

Consequently, the objective of this research is to determine the return to Washington apple growers' investments in generic and variety-specific promotion. Specifically, we seek to determine what type of promotion, if any, is more effective in increasing the returns to selling a relatively new product when consumer learning is explicitly taken into account. For this purpose, the return to promotion is defined as the increase in producer surplus relative to the amount spent on the campaign. In order to estimate the change in producer surplus, this study employs a three-step procedure that takes into account the impact of promotion at each level of the marketing channel—from retail demand through price-transmission to, ultimately, the impact on producer surplus.

The paper proceeds by first describing a market model of apple promotion. We use a Muth-type equilibrium displacement (MED) market-model that takes into account retail demand, price-transmission, grower supply, and market equilibrium. The second section presents the empirical models used to trace the effect of promotion from sales of all Washington apples, to specific varieties, and finally to farm prices through a farm-price linkage equation. The third section describes the data used to estimate and simulate the model, and explains the specific econometric methods involved. A fourth section presents the results from each stage of the analysis. A final section summarizes these results and presents some implications, limitations, and suggestions for future research.

A Conceptual Model of Washington Apple Promotion

Grower-returns to promotion are defined in terms of the net present value of a change in producer surplus resulting from a change in promotion expenditure, relative to promotion costs. Although the effects occur simultaneously, the model is best described in stages. First, a change in promotion spending causes a change in demand at the retail level to an extent measured by the promotion-response elasticity. Second, the change in farm price in response to this change in retail demand is determined by the price-transmission elasticity. Third, this change in demand causes a change in both the equilibrium quantity and price, as handlers respond to the higher price by bringing a greater supply to the market. Fourth, once a new equilibrium is achieved, producer surplus will be higher to the extent that both price and output are higher than before the promotion, but is reduced by producers' share of program costs. To calculate the change in producer surplus, we develop a model of the apple market.

By expressing equilibrium market variables in log-differential form, a MED model solves for the simultaneous impact of a change in promotion expenditure on retail demand, export demand, farm price, and farm supply. Equilibrium in the Fuji market requires export ($\boldsymbol{q}_x$) and retail ($\boldsymbol{q}_r$) demand to equal quantity supplied ($\mathbf{y}$) for each variety:

$$(1) \qquad \boldsymbol{w}_x d\ln\boldsymbol{q}_x + \boldsymbol{w}_r d\ln\boldsymbol{q}_r = d\ln\mathbf{y};$$

where $\boldsymbol{w}_r$ is the share of production sold at retail; $\boldsymbol{w}_x$ is the share sold as export. Retail demand depends upon prices ($\boldsymbol{p}$), exogenous retail demand shifters ($\boldsymbol{Z}_r$), Fuji-specific promotion ($\boldsymbol{A}_1$) and generic Washington apple promotion ($\boldsymbol{A}_2$):

$$(2) \qquad d\ln\boldsymbol{q}_r = \boldsymbol{N}_r d\ln p + \boldsymbol{G} d\ln\boldsymbol{Z}_r + \boldsymbol{B}_1 d\ln\boldsymbol{A}_1 + \boldsymbol{B}_2 d\ln A_2;$$

where $\boldsymbol{N}_r$ is a matrix of retail demand price-elasticities, $\boldsymbol{G}$ is a vector of elasticities with respect to the demand shift-variables, and $\boldsymbol{B}_k$ are matrices of promotion elasticities for the k^{th} type of promotion. Export demand is a function of prices and exogenous export demand shifters ($\boldsymbol{Z}_x$):

$$(3) \qquad d\ln\boldsymbol{q}_x = \boldsymbol{N}_x d\ln p + \boldsymbol{H} d\ln\boldsymbol{Z}_x .$$

where N_x is a matrix of export demand price elasticities and H is a vector of elasticities with respect to export-demand shift variables. Farm supply is a function of farm-level prices ($\boldsymbol{w}$):

$$(4) \qquad d\ln\mathbf{y} = \boldsymbol{E}_s d\ln\boldsymbol{w},$$

with supply-price elasticities $\boldsymbol{E}_s$, while farm prices are linked to downstream market prices through a price transmission equation:

$$(5) \qquad d\ln w = \boldsymbol{T} d\ln \boldsymbol{p}.$$

where $\boldsymbol{T}$ is a vector of price-transmission elasticities. Changes in producer surplus, allowing for the likelihood that the producer incidence of the per-unit WAC checkoff levy is less than 100%, are expressed as in Kinnucan, Xiao, and Hsia:

$$\Delta PS = \sum_i S_i^f p_i q_i d\ln w_i (1 + 0.5 d\ln y_i) - \Omega dA,$$

where S_i^f is the grower's share of the retail dollar for the i^{th} variety, dA is the change in both types of advertising, and Ω is an "incidence parameter" that measures the proportion of the per-unit checkoff levy that is borne by producers (Kinnucan 1999). The elements in (1) - (6) are solved simultaneously for the change in retail price by substituting (5) into (4) and combining (2) and (3) into (1). Simplifying the result then provides a reduced form expression for the change in retail price in response to a change in either type of promotion or the other exogenous factors, such as consumer experience or apple expenditure:

$$(7) \qquad d\ln \boldsymbol{p} = \mathbf{M}^{-1} \boldsymbol{G} d\ln \boldsymbol{Z}_r + \boldsymbol{M}^{-1} \boldsymbol{H} d\ln \boldsymbol{Z}_x + \boldsymbol{M}^{-1} \boldsymbol{B}_1 d\ln \boldsymbol{A}_1 + \boldsymbol{M}^{-1} \boldsymbol{B}_2 d\ln \boldsymbol{A}_2,$$

where $\boldsymbol{M} = \boldsymbol{E}_s \boldsymbol{T} - w_r \boldsymbol{N}_r - w_x \boldsymbol{N}_x$. The resulting change in market price is then used to calculate the change in farm price (5) and shipper supply through (4) and the change in producer surplus through (6). Comparing the present value of changes in producer surplus to the present value of the cost of its provision provides an estimate of the returns to promotion, expressed in terms of a present value net benefit:cost ratio. The following section develops a two-stage model of consumer demand that is used to estimate the elasticities used in this simulation, incorporating promotion both at the category and variety levels.

A Two-Stage Model of Fuji Demand and Promotion

There are several reasons why a two-stage model of demand is particularly useful in evaluating the effectiveness of promotion expenditures. First, efforts to increase demand can change both the demand for an entire category, or just reallocate spending among specific products within the category (Duffy). While specific efforts may be made in promoting a particular variety of apple, consumers often fail to identify varieties or brands of any type in fresh produce so these efforts tend to spillover or affect the demand for related products. Second, generic messages intended to increase total apple category sales will have different effects on the sales of each variety. Third, these interaction effects may reduce the total value of category sales if the reallocation is toward low-price varieties—a situation that is of particular concern to retailers. Therefore, determining the relative importance of each of these effects requires a model of both category and variety demand.

To be consistent with the requirements of consumer utility-maximization, this study uses a two-stage budget allocation model (Hausman). This approach assumes consumers allocate a fixed amount of income in the first-stage between apples, various other fruits, and all other consumer goods, while they allocate apple expenditure among varieties at the second-stage. This theoretical consistency, however, comes at a cost of imposing a very specific structure on the demand model. Specifically, Gorman demonstrates that two-stage models can only be consistent with utility maximization by assuming preferences are homothetically separable, or that they are strongly separable into sub-branches that are of generalized Gorman polar form.[1] Because the first alternative imposes the untenable restriction that each element of the variety (lower stage) model has unitary expenditure elasticities, this study adopts the latter. Examples of this approach include Brown and Heien, Blackorby et al., Yen and Roe, and Gao, Wailes, and Cramer. Specifying a demand system consistent with these restrictions also means that the price indices at the upper level are perfect price indices for each sub-group, so estimating the entire system through the iterative process of Anderson provides consistent estimates of both the structural and promotion elasticities at each level. One specification that meets these restrictions consists of an upper stage Linear Expenditure System (LES) and a lower stage Almost Ideal Demand System (AIDS).

Deaton and Muellbauer provide a derivation of the LES model which this paper extends to include promotion. Pollak and Wales suggest including other arguments of the utility function as scaling factors, or variables that cause the effective price faced by consumers to vary by their exposure to advertising. Using upper case letters to denote the upper or category level of demand for a single

[1] It is also true that blockwise dependence at the group level combined with a conditional second stage is consistent with utility maximization, so our approach is not the only way to approach this problem.

product group I, and defining the scaling function as:

(8) $$M_I = 1 + \theta_I(A_I/P_I)\ln P_I,$$

multiplying prices in the LES expenditure function and re-deriving the demand system leads to an upper-level demand model similar to Chang and Green:

(9)
$$X_I = P_I Q_I = P_I \Psi_I + \theta_I \Psi_I A_I + B_I\left(Y - \sum_J \Psi_J P_J\right),$$

where X_I, is the expenditure on category I, Y is per capita income, P_I is a price index defined over the components of category I, B_I is the marginal budget share, A_I is the amount of advertising expenditure on category I, and Ψ_I measures the subsistence amount of expenditure on I. For this equation to be part of a system of demand equations that is consistent with constrained utility maximization, all $B_I \geq 0$, $\Sigma B_I = 1$, and $Q_I \geq \Psi_I \ \forall \ I$.[2] Assuming consumers' tastes are influenced by habit, the subsistence parameters in (9) are allowed to vary with past expenditure levels: $\Psi_I = \Psi_I^* + \tau_I(P_I Q_I)_{t-1}$, where Ψ^* refers to the long-run or steady state level of the subsistence parameter, while τ shows the marginal change in subsistence demand in past levels of total expenditure. Allowing for these dynamic effects is important as many consider advertising a long-lived asset (goodwill) whose influence depreciates slowly over time as the message is forgotten (Nerlove and Arrow; Ehrlich and Fisher), becomes obsolete as new products come to the market (Kotler), or is superceded by strategic promotions from oligopolistic rivals (Erickson, Sorger). Further, promotion carryover may arise because a threshold level of knowledge may be required before purchase initiation occurs, patterns of brand loyalty take time to establish, habits may require repeated efforts to break (Chang), or simply that the process of disseminating information is not instantaneous. Similar considerations for promotion carryover enter the second-stage model.

At the variety-demand stage, a linear Almost Ideal Demand System (LAIDS) satisfies the requirement for two-stage budgeting because the implied preferences are of Gorman polar form (Deaton and Muellbauer). Scaling prices in the AIDS expenditure function by the function $m_i(A_i) = A_i^{\delta_i}$ and applying Shephard's Lemma leads to promotion-augmented share equations of the form:

(10)
$$s_i = \alpha_i + \sum_j \gamma_{ij}\ln p_j - \sum_j \gamma_{ij}\delta_j \ln A_j + \beta_i \ln(X_I/P_I),$$

where A_j are variety-specific promotion expenditures, s_i is the share of variety i $(p_i q_i/X_I)$; p_i is the price of variety i; X_I is the amount of expenditure on the I commodity sub-group, and $\ln P_I$ is a Stone price index for this group such that $\ln P_I = \Sigma_i w_i \ln p_i$.[3] As in the first-stage model, the dynamics of apple variety consumption are modeled by specifying (10) as a geometric lag, or partial adjustment model. This specification not only captures consumers' tendency to form habits in consuming particular apple varieties, but also allows advertising expenditures in one period to influence demand in all future periods, is consistent with adding up, and is relatively parsimonious. While (10) is a common specification for the effects of promotion on demand, the dynamics of demand for new products are often driven by more than just habits, but learning and experience as well (Nelson).

Experience is especially important for goods whose characteristics are difficult to convey, and highly variable—even items that are the same variety and from the same source. Therefore, accumulated consumption of a new product may also explain much of the increase in demand typical of the growth stage in the life cycle of a new product—through both consumers' self discovery and through knowledge gained by word-of-mouth, or learning from others (McFadden and Train). The notion of a product life cycle implies that information from experience and promotion are likely to have different effects on the demand for mature and new varieties. New apple varieties require a promotion strategy that generates awareness and initiates first-purchase, whereas reinforcement through price-promotions and discounts becomes more important with maturity. By allowing each share intercept to vary with cumulative consumption: $\alpha_i = \alpha_{0i}^* + \alpha_{1i}^*\Sigma_{t=0}^T q_t$, the variety demand model incorporates an indicator of consumption experience, or stage of the product life cycle. Failing to include the effect of consumption experience would likely lead to estimates that overstate the role of both prices and promotion in increasing variety demand.

Combining estimates of the first- and second-stage demand parameters leads to long-run elastic-

[2] This particular scaling function is chosen such that quantity demanded depends upon real, rather than nominal levels of advertising.

[3] Although the linear approximate version of the AIDS model is frequently used in applied demand studies, there are many problems with a Stone price index. Many of these are documented by Moschini, who also shows that a Stone price index is, nonetheless, a proper price index if applied to appropriately scaled data, which is the case here.

ities of variety sales with respect to prices and promotion that take into account both the category and variety response, so the total price elasticity of demand is written as (Goddard and Conboy):

(11)
$$\epsilon_i = \left(\frac{\gamma_{ii}}{s_i} - \beta_i\right) + \left(\frac{\beta_i}{s_i} + 1\right)\left(\frac{\Psi_I s_i P_I}{X_I}(1 - B_I)\right) - 1.0,$$

and the cross price elasticity:

(12)
$$\epsilon_{ij} = \left(\frac{\gamma_{ij} - \beta_i w_j}{w_i}\right) + \left(\frac{\beta_i}{w_i} + 1\right)\left(\frac{\Psi_I w_i P_I}{X_I}(1 - B_I)\right),$$

and the total long-run promotion elasticity is written as:

(13) $$\epsilon_{i,A_i} = \left(\frac{\delta_i}{s_i}\right)(1 - \beta_i \ln p_i) + \left(\frac{\beta_i}{s_i} + 1\right)\left(\frac{\theta_I A_I}{X_I}\right).$$

In calculating these elasticities, prices, budget shares, promotion-stock amounts, and expenditure levels in (11)–(13) are each evaluated at their respective means and variety-specific adjustment coefficients are used to express the long-run value of each parameter. Although these elasticities indicate the responsiveness of retail apple sales to changes in prices, promotion, and expenditure, changes in producer surplus depend upon the farm price transmission elasticity.

Whereas other studies use synthetic price transmission elasticities (for example, Kinnucan, et al.), this study estimates this elasticity using a reduced-form marketing margin equation derived from a model of optimal shipper behavior. Factors that explain the difference between farm and retail prices include labor and transportation costs, export-market price premiums, domestic product-differentiation, and lags in the adjustment of farm prices to changes in retail demand. To account for imperfectly competitive price-determination, the model introduced here is a price-markup specification similar to Schroeter and Azzam. With this model, the profit maximization problem faced by a representative apple distributor is written as:

(14) $$\max_{q^r} \pi_i = \max_{q^r}[(p^r - kp^f)q^r - c(\mathbf{w}, q^r)],$$

where q^r is the retail quantity; p^r is the retail price; p^f is the farm price; k is a constant of proportionality representing shrinkage and loss from the orchard to the store, and $c(\mathbf{w},q^r)$ is the cost of selling apples with input prices, $\mathbf{w}$. Because apple distributors have the option of buying Fujis for domestic sale, or for export sale (q^x), or other more established varieties (q^o), the retail price is a function of the relative demand for each: $p^r = f(q^r,q^x,q^o)$. If the proportion of exported to total apples rises, then farm prices are likely to rise due to the premium earned from off-shore sales.[4] However, a rise in domestic Fuji sales relative to existing varieties is likely to mean the erosion of the new product premium commanded by Fujis. Defining ϵ_d as the retail elasticity of demand for Fujis, ϵ_x as the elasticity of export demand, ϵ_o as the elasticity of mature varieties, θ_x as the conjectural variation of export demand with respect to retail demand (dq^x/dq^r); and θ_o as the conjectural variation of mature variety sales with respect to Fuji retail sales, aggregating over a homogeneous set of distributors provides a solution to (14) for the long-run or steady-state farm price, p^{f*}:

(15) $$p^{f*} = (p^r/k)(1 + 1/\epsilon_d) + (p^r/k)\left(\frac{q^r}{q^x}\right)\epsilon_x^{-1}\theta_x + (p^r/k)\left(\frac{q^r}{q^o}\right)\epsilon_o^{-1}\theta_o - \frac{\partial c}{\partial q^r}.$$

Although this shows how farm prices are ideally linked to retail prices, marketing costs, and quantities that flow into alternative markets, farm prices rarely respond instantaneously to changes in retail prices (Heien; Ward 1982; Kinnucan and Forker; Powers 1995).

Rather, suppose the farm price changes only a proportion of the way towards equilibrium during any given period, t. This slow adjustment could be due to costs of adjusting prices, lags in moving information through the system, or a conscious realization on the part of buyers that it is in their interests to delay farm price increases in the face of rising retail apple prices. Simplifying the right-side of (15) as M_t, let $p_t^{f*} = \phi M_t$. If prices adjust a proportion, λ, towards this amount each period, then (15) becomes:

(16) $$p_t^f = \phi(1 - \lambda)M_t + \lambda p_{t-1}^f + e_t.$$

where e_t is a random error in adjusting the retail price. In linear form, the estimated econometric model becomes:

(17)
$$p_t^f = \alpha_0 p_{t-1}^f + \alpha_1 p_t^r + \alpha_2 p_t^r(q_r/q_x) + \alpha_3 p_t^r(q_r/q_o) + \sum_{j=1}^{2} \alpha_j w_j + e_t,$$

[4] Export premiums are possible due to the successful differentiation of Washington apples from others on world markets. As evidence of this differentiation, WAC marketing officials cite research conducted in Mexico that finds brand awareness of "significantly greater than 80%" (Washington Apple Commission 1997d). As a result, Washington apple growers have some ability to price discriminate between the domestic and off-shore markets.

Table 1. Price, Quantity, and Promotion Summary Statistics

Variable[a]	N	Mean	Variance	Minimum	Maximum
P_{Red}	1044	0.97	0.06	0.25	1.19
P_{Gold}	1044	0.85	0.00	0.67	1.09
$P_{Granny\ Smith}$	1044	0.71	0.00	0.50	1.08
P_{Fuji}	1044	1.00	0.01	0.61	1.42
P_{Gala}	1044	0.92	0.01	0.61	1.60
$P_{Braeburn}$	1044	0.96	0.03	0.54	1.55
$P_{Jonagold}$	1044	0.89	0.04	0.39	1.44
P_{Rome}	1044	0.75	0.01	0.42	1.12
Q_{Red}	1044	525.00	355.22	7.27	3565.80
Q_{Gold}	1044	194.65	44.75	3.16	1359.30
$Q_{Granny\ Smith}$	1044	76.44	6.64	0.04	578.73
Q_{Fuji}	1044	73.25	32.68	0.00	1540.10
Q_{Gala}	1044	67.72	18.60	0.00	1042.80
$Q_{Braeburn}$	1044	28.05	2.74	0.00	382.14
$Q_{Jonagold}$	1044	15.51	0.98	0.00	355.46
Q_{Rome}	1044	12.44	0.50	0.00	274.44
A_{Fuji}	1044	180.90	43159.00	0.00	6882.80
$A_{TotalWAC}$	1044	4645.70	64758.00	0.00	5843.00

[a]Quantities are in thousands of pounds per market per week. Prices are \$/pound. Quantity variance values are scaled by factor of 1×10^3 for presentation purposes.

and is estimated by pooling the data from all markets, while allowing for market-specific retail price effects.[5] Because of the likely endogeneity of retail prices, an instrumental variables method is used to estimate the model. The following section describes the data and specific methods used in estimating both the demand model and this price linkage specification.

Data and Methods

The data used in this analysis are drawn from a variety of sources made available by the WAC, including the *Market Vu*, *Ad Activity*, and *Unloads* reports, from September 1995 to May 1997 on a weekly basis. These reports contain data on prices, promotion activities, and shipments to a large number of markets, respectively and are summarized in table 1. In order to make the analysis tractable, the study focuses on a set of sample markets consisting of Charlotte, Los Angeles, Minneapolis, Philadelphia, Phoenix, Richmond, San Antonio, San Francisco, Seattle, St. Louis, Tampa, and Washington, D.C. Because of the geographic dispersion of these markets, the retail price data exhibit considerable variability.

The entire LES/AIDS system is estimated with this weekly data pooled over the twelve sample-cities, giving a total of 1,044 observations. In fact, pooling variety-specific data over time and markets means that prices vary by city, week, and variety. The *Market Vu* data not only satisfy this requirement, but also provide price data on per pound, retail-level basis on apple grade, size, container, source, and quality, as measured by a subjective scale developed by WAC field staff. In order to define a "standard" apple of each variety in each market and in each week, a hedonic price-correction method adjusts for all other effects on price (Goldman and Grossman; Cox and Wohlgenant). Because the shipment data from the *Unloads* report are defined on a zip code basis, market definitions corresponding to those used in the *Market Vu* reports are found by aggregating over all contiguous zip codes within a market area. Details on this aggregation process are available from the authors. Shipments are reported in terms of numbers of cartons per market. These markets, in turn, correspond closely to those used by WAC marketing officials in allocating promotional and advertising budgets across different regions.

Budgeted amounts for all retail promotion activities are provided by the WAC Retail Marketing Department. The budget reports contain lines for each retail account, defined by store and market. Another data source, the *Ad Activity Report*, prepared by Leemis Market Research, reports the

[5] In choosing this method of pooling, we compared a model with market-specific price effects to one where all coefficients vary by market and one in which none of the coefficients varied by market. While we could not reject the null hypothesis that the non-retail price exogenous variable coefficients are equal across markets (F = 0.0271), we could reject the null hypothesis that the price-coefficients, and hence the farm-retail price transmission elasticities, are equal for every market (F = 22.3421).

gross rating points (GRPs) for Fujis and all other Washington apple variety advertisements. GRPs for each retail account and budget period are used as weighting factors in allocating budget expenditures over time to either Fuji apples or all other varieties. These data are augmented by mass media expenditure values prepared for the WAC by McCann-Erickson, giving us access to data for both Fuji promotion expenditures and for expenditures on all other apples.

For purposes of the category-level model, the Washington apple price variable is a Stone's price index calculated over all varieties. An average price for apples from all other sources is calculated from the *Market Vu* reports on a market-by-market basis. Prices for alternative fruits (bananas, grapes, and fresh navel oranges) are taken from the Bureau of Labor Statistics (BLS) *Consumer Price Index: Average Price* database, while regional CPI values are from BLS *Consumer Price Index: State and Area* data. This index is used as a proxy for the price of "all other consumption goods" in the first-stage model. Personal disposable income is from the Bureau of Economic Analysis *Regional Programs* data, while population values are from the Bureau of Census *State Population Estimates*.

In estimating the retail-farm price transmission elasticity, marketing costs are measured by the price of No. 2 diesel fuel, taken from *Monthly Energy Review*, and the wage rate for production workers in SIC 21 (food and kindred products) taken from *Employment and Earnings*. The farm prices are from the Washington Growers' Clearing House. With these data, estimates of the price transmission elasticity are found for each market using independent, single-equation regressions. Because of the endogeneity of several explanatory variables in (16), these equations are estimated using an instrumental variables procedure, where the set of instruments includes all exogenous variables and lagged values of all endogenous variables. Simple OLS estimation is also inadequate for the demand system. Estimating the LES/LAIDS demand model requires a procedure that recognizes the relationship between prices at the second-stage and price-aggregates at the first-stage of the budgeting problem.

Consequently, this study uses Anderson's iterative two-stage procedure to ensure that the Washington apple price index is indeed a true or "perfect" index of varietal prices. An iterative approach captures the effect of substitution between varieties on the first-stage price index because the index-weights are functions of the second-stage parameters, and the second-stage parameters are, in turn, functions of expenditures at the first-stage. Anderson's method is well understood and is described in detail in Gao, Wailes, and Cramer. To maintain consistency with constrained consumer budgeting, both homogeneity and symmetry are imposed on the second-stage LAIDS model.[6] With this approach, however, the usual adding up condition does not apply because the errors in the second-stage system sum to the error in the first-stage model and not to zero (Anderson). Therefore, all varieties are retained in the LAIDS model. Further, although the parameter estimates from this two-stage approach are consistently estimated, their standard errors are not. However, when the generated regressors are not lagged, Hoffman (1987) demonstrates that the induced variance bias can be expected to be quite small. Given this caveat, the resulting elasticity estimates are then used to determine the net effect of promotion and cumulative consumption on Fuji prices, allowing for feedback effects through other apple varieties.

Because changes in producer surplus are likely to be affected by each of the assumed parameter values, alternative results are obtained and reported for higher and lower values of: the grower share of the retail dollar, the elasticity of supply from apple shippers, and the retail elasticity of demand. Growers and WAC officials alike are also interested in the effectiveness of the "Year of the Fuji" campaign, so simulations for each parameter regime are conducted for the entire sample and for only the 1997 observations. Further, these simulations compare the relative contribution of each source of knowledge in increasing demand by conducting experiments where: (1) cumulative consumption and total WAC promotion are held constant, and Fuji-specific promotion is increased by 10%; (2) cumulative consumption and Fuji-specific promotion are held constant and total WAC promotion is increased by 10%; (3) both types of promotion are held constant and cumulative consumption rises by 10%; and (4) total WAC promotion is held constant while both Fuji-specific promotion and cumulative consumption are increased by 10%. The results of each scenario are compared on the basis of increment to producer surplus and, for the promotion variables, the benefit-to-cost ratio of investing in promotion. The next section presents these results after a brief discussion of the structural demand and price-linkage estimates.

[6] Tests of symmetry and homogeneity fail to reject the null hypothesis in both cases. Durbin and Watson's d test fails to reject the null hypotheses of no positive nor negative autocorrelation for all share equations.

Table 2. LES Elasticity Estimates of Aggregate Washington Apple Demand: Long Run

Variable	Elasticity Estimate	t-ratio
Wash. Apple Price[a]	−0.1768*	−2.9144
Other Apple Price	0.0533*	2.4831
Banana Price	0.4226	1.7479
Grape Price	0.0545	1.9587
Navel Orange Price	0.8643*	9.1201
Other Consumer Good Price	0.2122*	2.2247
Personal Disposable Income	1.7412*	6.6029
Total WAC Promotion	0.0174*	2.4756

[a]A single asterisk indicates the estimate is significant at a 5% level. This model also included binary market variables, but they are not displayed here for brevity's sake. Model estimates are obtained by pooling data over twelve sample markets and eighty-eight weeks of Fuji shipments.

Results and Discussion

Although the key results of this paper concern the calculated returns to Fuji apple growers' promotion investments, the structural demand and farm-price linkage parameters are also of considerable interest for future promotion planning. Table 2 shows the elasticity estimates from the first stage of the model. These results suggest that apples are habitually-purchased items that respond very little to changes in price, but are relatively sensitive to changes in income. Price-inelastic demand is perhaps to be expected from a good with a small budget share, but the strong substitute relationship with navel oranges is not. Of greater concern to this study, however, is the effect of aggregate WAC promotion on the Washington apple category. The elasticity of Washington apples with respect to all-promotion suggests that WAC promotion does indeed increase Washington apple sales in aggregate, irrespective of its individual variety effects.

These variety effects are estimated in the second-stage LAIDS model. The total elasticities in table 3 show whether advertising or price-promotion simply reallocates demand among varieties, or expands overall demand. These elasticities imply that Red Delicious, Golden Delicious, Granny Smith, Gala and Rome apples are inelastic in demand, whereas each of other varieties is price-elastic. Although not conclusive evidence, this pattern suggests that each of the newer, or specialty varieties (Fuji, Braeburn, Jonagold) is more price-elastic than the traditional, more mature varieties. In fact, specialty apples also tend to have expenditure elasticities greater than one, lending some evidence to the contention that they are luxury goods. In terms of cross-price elasticities, only Braeburns are Fuji-substitutes, while many of the others appear to be complementary. Therefore, higher (but opposing) spillover responses to Fuji promotion are expected for these other varieties.

In fact, Braeburns and Galas appear to respond positively to Fuji promotion, although the effect is only statistically significant at a 10% level. No variety exhibits a significant negative cross-response to Fuji promotion. This lack of significance may mean that when both aggregate and share-effects are taken into account, Fuji-specific promotion does not cannibalize net sales of other varieties. Somewhat surprisingly, however, sales of Red Delicious apples, long the dominant variety from Washington State, respond to neither Fuji promotion nor total WAC expenditures. Given the relatively strong impact of WAC marketing efforts on sales of Golden Delicious, Fuji, Gala, Braeburn and Jonagold apples, this result suggests that the WAC's own efforts are at least in part responsible for the relative decline of the Washington Red Delicious apple. Taken together, these results suggest that promotion as a source of information is particularly valuable for specialty varieties. These varieties are, however, less homogeneous with respect to the impact of either habit persistence or cumulative consumption.

Although not shown in table 3, each of the adjustment coefficients associated with the geometric lag specification is significantly different from zero. Moreover, these estimates imply adjustment periods, or the number of weeks required to substantially eliminate the gap between actual and desired consumption levels, of between 7.18 weeks for Rome apples to 12.89 weeks for Braeburns.[7] Changes to the level of Fuji promotion, therefore, can be expected to persist for 9.85 weeks beyond their initiation—a result that is broadly consistent with other studies that estimate the dynamic effects of promotion (Cox). Accounting for habit persistence may be largely responsible for the lack of significance of cumulative consumption for most varieties. In particular, the tendency for consumers to learn from their own experience or by word of mouth is only significant in the case of Fuji apples. This is perhaps to be expected, given that consumers' acquisition of variety-knowledge should favor those varieties that represent true improvements on existing apples. Therefore, while the experiential nature of Fujis remains important, promotions

[7] The number of periods (n) required to adjust a proportion (p) toward the desired level of consumption is given by: $n = \log(1 - p)/\log\lambda$, where λ is the estimated adjustment coefficient. For our purposes, 99.9% adjustment is deemed to be complete.

Table 3. Total Elasticities of Demand: Top Eight Varieties of Washington Apples

	Red[a]	Gold	Gran	Fuji	Gala	Brae.	Jon.	Rome	Exp	Fuji Promo.	WAC Promo.	Cumulative Consump.
Red	−0.683*	0.020	0.341*	0.849*	0.162	0.305*	0.554*	0.123	0.867*	0.004	−0.006	−0.010
	(−12.312)	(0.126)	(2.567)	(8.853)	(1.375)	(4.711)	(9.559)	(1.037)	(24.667)	(0.913)	(−1.775)	(−0.779)
Gold	−0.806*	−0.201*	−0.162	−0.393*	−0.008	0.264*	0.157	−0.189	1.008*	−0.016	0.017*	−0.015
	(−7.420)	(−2.633)	(−0.618)	(−2.109)	(−0.034)	(2.092)	(1.447)	(−0.805)	(14.605)	(−1.878)	(2.435)	(−0.518)
Gran.	−1.339*	−0.221	−0.406	−0.150	0.523	0.225	−0.322	−0.047	1.089*	−0.020	−0.018	0.008
	(−6.909)	(−0.394)	(−0.872)	(−0.458)	(1.271)	(1.009)	(−1.685)	(−0.114)	(8.891)	(−1.327)	(−1.511)	(0.139)
Fuji	−1.621*	−1.561	−0.551	−1.137*	−0.106	0.199	−0.436	−0.466	1.642*	0.140*	0.060*	0.158*
	(−5.646)	(−1.859)	(−0.788)	(−6.438)	(−0.175)	(0.596)	(−1.545)	(−0.753)	(8.985)	(6.237)	(2.693)	(4.907)
Gala	−1.357*	−0.730	0.537	−0.500	−0.323*	−0.813*	−0.705*	3.072*	1.150*	0.042	0.079*	−0.092
	(−4.825)	(−0.892)	(0.786)	(−1.056)	(−2.544)	(−2.495)	(−2.562)	(5.072)	(6.438)	(1.925)	(4.493)	(−1.539)
Brae.	−1.120*	−1.244	−1.010	0.051	−0.536	−1.252*	−0.785*	1.293	1.887*	0.044	0.073*	0.033
	(−2.911)	(−1.090)	(−1.061)	(0.078)	(−0.647)	(−2.689)	(−2.044)	(1.535)	(7.545)	(1.437)	(2.976)	(0.428)
Jong.	−0.843*	2.168	0.831	−2.148*	−0.486	−0.279	−1.131*	3.225*	1.426*	0.035	0.108*	−0.007
	(−2.180)	(1.909)	(0.886)	(−3.234)	(−0.594)	(−0.624)	(−3.001)	(3.802)	(5.816)	(1.152)	(4.471)	(−0.083)
Rome	−0.002	0.927	0.044	−1.919*	1.476	1.202*	−0.170	−0.962	0.697*	−0.016	0.032	−0.125
	(−0.005)	(0.823)	(0.047)	(−2.896)	(1.774)	(2.683)	(−0.444)	(−1.160)	(2.842)	(−0.521)	(1.342)	(−1.093)

[a]A single asterisk indicates significance at a 5% level.

aimed at helping consumers acquire this information may prove most effective. Although these results show a strong impact of both promotion and cumulative consumption on retail-demand, the ultimate return to growers depends upon how much of this is passed on in terms of higher farm prices.

The extent to which changes in retail demand lead to changes in farm price is given by the farm-retail price transmission elasticity, which is estimated with equation (17). These results show that farm prices do not adjust instantaneously to changes in retail demand, requiring roughly 5.5 weeks before 90% of the change at retail is reflected in the farm price. This result is slightly longer than that obtained by Powers (1995) for iceberg lettuce, or Ward (1982) in fresh vegetables or Kinnucan and Forker for dairy products. Further, farm prices rise with the share of Fujis that are exported as more apples are sold into the premium market, but farm prices fall in Fujis' domestic market share. This latter effect may be due to a maturing Fuji market—as a new variety matures or moves through its product life-cycle it necessarily becomes less of a specialty item, commanding less of a premium in the retail market. As expected, farm prices fall with both wages and fuel prices as both are critical components of the cost of marketing apples. The key result from this model, however, is the price-transmission elasticity, or the percentage change in farm price for a given percentage change in the retail price.

Using the results in table 4, the average long-run price-transmission elasticity for Fuji apples is 0.65.[8] For all other varieties, the transmission elasticity is calculated using an expression from Gardner:

$$(18)\ T_i = (\sigma_i + e_b)/[\sigma_i + S_i^f e_b + (1 - S_i^f)e_a];$$

where σ_i is the elasticity of substitution between farm and marketing inputs; e_a is the elasticity of supply of farm inputs; e_b is the elasticity of supply of marketing inputs; and S^f is the farm-share of the retail dollar. As in Kinnucan, et al., σ_i is assumed to be zero, while S_i^f is taken from the data. Unlike Kinnucan et al., however, the values for e_a and e_b are 1.30 and 0.50, respectively. These values are chosen by fixing e_b at a plausible value and then calibrating (18) to be consistent with the estimated Fuji transmission elasticity. Using these transmission elasticities, equation (6) provides estimates of the effect of changing promotion and experience on producers' surplus.

Table 4. Farm-Retail Price Linkage Equation: Pooled 2SLS Estimates

Variable[a]	Estimate	t-ratio
P^f_{t-1}	0.661*	31.351
P^r_1	0.121*	3.541
P^r_2	0.139*	4.443
P^r_3	0.134*	4.158
P^r_4	0.129*	3.901
P^r_5	0.142*	4.599
P^r_6	0.108*	3.001
P^r_7	0.144*	4.543
P^r_8	0.141*	4.543
P^r_9	0.134*	4.126
P^r_{10}	0.112*	3.159
P^r_{11}	0.129*	3.761
P^r_{12}	0.126*	3.805
W_{fuel}	−0.146*	−2.821
W_{wage}	−0.003*	−5.634
$\bar{P}^r(q^x/q^r)$	0.108*	7.779
$\bar{P}^r(q^o/q^r)$	−1.665*	−14.061
R^2	0.751	

[a]In this table, a single asterisk indicates significance at a 5% level. The variables are as defined in equation (19), where P_i^r indicates the retail price in market i, $\bar{P}^r$ is the average retail price across all markets, and P^f_{t-1} is the lagged farm price.

In order to test the sensitivity of changes in producer surplus to different values of the model parameters, alternative simulations are conducted as described above. To answer the objectives of this paper, "grower returns" to promotion or experience are defined both in terms of the present value increment to producer surplus and the ratio of the change in the present value of net benefits to the change in the present value of costs of promoting. The simulation results for both the entire sample period and the "Year of the Fuji," assuming a 5% interest rate, are shown in table 5.

In the base scenario, the price-elasticity of Fuji demand is set at −1.14 and the elasticity of supply at 1.30. For all simulations, the full N_r matrix is used, while the E_s matrix is assumed to be diagonal.[9] Given the base-case assumptions, the simulation results in table 5 show that increasing Fuji promotion by 10% causes producer surplus to rise by \$0.43 million over the entire sample period,

[8] Kinnucan and Forker derive farm-retail price transmission elasticities for milk that consistently exceed 1.0, claiming that the opposite case, as found here, is somewhat anomalistic. However, Gardner's condition for $T_i < 1.0$, using his equation for the transmission elasticity, is simply that $e_a > e_b$. In the weekly data of this study, this scenario is not only plausible, but highly likely as marketing costs are largely fixed in the short-run, while shipments from cold storage are highly elastic.

[9] The incidence parameter is calculated as (Kinnucan 1999):

$$\Omega_x = [\eta + k|e_D|]/[\eta + k|e_D| + (1 + k)\tau e_S],$$

where η is the elasticity of domestic demand (1.137 in absolute value), k is the proportion traded (0.443), e_D is the elasticity of export demand (1.0 in absolute value), $\tau = p/(p - t)$ where t is the per-unit levy (\$0.25 per box), and e_S is the elasticity of import supply (1.30).

Table 5. Grower Returns to Fuji and WAC Promotion Expenditure: November 1995–May 1997

	Fuji Promo		All WAC Promo		Fuji Cumulative		Fuji Promo & Cumulative	
	Entire Sample	Year of the Fuji	Entire Sample	Year of the Fuji	Entire Sample	Year of the Fuji	Entire Sample	Year of the Fuji
	Change in Producer Surplus ($ '000)							
Base Case[a]	420.6	80.7	–400.3	–395.9	1211.2	703.8	1649.1	794.9
High Farm Share	910.4	365.7	–289.1	–331.3	1771.2	1029.1	2708.2	1410.2
Low Farm Share	134.5	–85.0	–464.9	–443.4	885.6	514.6	1033.7	437.3
High Supply Elasticity	–25.5	–178.2	–482.7	–443.8	719.4	417.9	703.2	245.3
Low Supply Elasticity	1454.2	681.6	–297.4	–336.1	2331.5	1354.7	3837.6	2066.5
High Demand Elasticity	–175.4	–173.5	–499.4	–453.3	711.3	413.3	699.8	243.3
Low Demand Elasticity	1563.3	745.0	–144.1	–242.7	2519.4	1463.9	4160.2	2253.8
	Benefit/Cost Ratio							
Base Case	6.33	1.22	–0.27	–0.75	N.A.	N.A.	24.85	12.03
High Farm Share	13.72	5.54	–0.19	–0.63	N.A.	N.A.	40.82	21.35
Low Farm Share	2.03	–1.29	–0.32	–0.82	N.A.	N.A.	15.58	6.62
High Supply Elasticity	–0.39	–2.70	–0.33	–0.84	N.A.	N.A.	10.60	3.71
Low Supply Elasticity	21.92	10.32	–0.20	–0.64	N.A.	N.A.	57.84	31.29
High Demand Elasticity	–0.26	–2.63	–0.34	–0.86	N.A.	N.A.	10.55	3.68
Low Demand Elasticity	23.56	11.28	–0.18	–0.47	N.A.	N.A.	62.02	34.12

[a]In this table: Base Farm Share = 0.547, High Farm Share = 0.80, Low Farm Share = 0.40; Base Supply Elasticity = 1.30, High Supply Elasticity = 2.0, Low Supply Elasticity = 1.0; Base Demand Elasticity = –1.137, High Demand Elasticity = –2.0, Low Demand Elasticity = –0.5. Export demand elasticity held at –1.0 for all cases. N.A. means that the measure is not applicable.

implying a benefit:cost ratio (BC) of 6.33:1. However, this BC ratio falls to 1.22 for the "Year of the Fuji" campaign. This reduction in returns over the later period may be due to one of many factors. First, promotional expenditures are likely to exhibit declining marginal returns—beyond a minimal amount required to establish a market presence, each additional dollar of expenditure generates a lower increment in sales than did the previous one. Second, by early 1997 the number of consumers who had not yet tried Fuji apples is likely to have been very small. If this is the case, then the ability of promotion to precipitate new purchases has passed and the role of advertising then becomes one of building purchase habits instead. Whereas promotion is necessary to establish a new product in the market, such high rates of return associated with the rapid growth phase of a product's life-cycle are unlikely to be sustainable as purchases become more habitual and price-sensitive. Third, lower retail prices may be responsible for more of the increase in Fuji consumption than in the past. Although the returns to promotion appear attractive under the base-case scenario, they are quite sensitive to alternate parameter assumptions.

There is some question as to whether a higher grower-share should result in higher or lower returns to promotion, *ceteris paribus*. Whereas Kinnucan (1997) argues that a higher grower-share means that the derived demand for farm products becomes more elastic, thus reducing the benefit to advertising, growers nonetheless receive a greater proportion of whatever surplus may be generated. However, differentiating (6) with respect to grower share, and using the particular parametric assumptions used herein, the effect of a higher grower share on grower surplus is unambiguously positive. Therefore, it is not surprising to find that the BC ratio of a 10% increment to Fuji promotion is 13.72 over the entire sample if growers receive 80% of the retail dollar, but falls to 5.54 if they receive only 40%. This latter scenario could arise if marketing costs rise significantly, if consolidation at the retail level substantially increases apple buyers' power to set prices, or if significant competition for retail space arises from other regions' apples, or even other products within the produce section.

Similarly, sensitivity analysis with respect to the supply elasticity is necessary because little is known of its true value in weekly data with significant amounts of storage. If supply is unit-elastic (1.0), the BC ratio resulting from a 10% increment to Fuji promotion is 21.92. In this scenario, any increase in demand will cause farm prices to rise significantly, while causing little changes in quantity supplied. However, a supply elasticity of 2.0

causes the return to promotion to fall to –0.39, as growers respond to higher prices by increasing the quantity supplied more than proportionately. Because incremental producer surplus is not able to cover growers' costs of financing the program, the net return becomes negative. However, such a supply elasticity is unlikely in the medium and long run for an agricultural product subject to significant production lags and constraints on land, labor, and other key inputs. Changing the elasticity of retail demand also produces the expected changes in returns to promotion as a demand elasticity of –0.5 provides a BC estimate of $23.56 for the next dollar invested, suggesting that this promotion will become more profitable if demand becomes less elastic as Fujis mature as a variety. The generally positive rates of return to Fuji specific promotion, however, change both qualitatively and quantitatively with respect to the generic WAC program.

Specifically, the BC ratio for a 10% rise in total WAC promotion produces a negative return under every parameter scenario. Negative returns are due both to the small estimated response elasticities and the sheer size of overall promotion expenditures, again implying strong diminishing marginal returns to promoting apples. These results, however, do not take into account the value of consumers' learning about the positive attributes of Fujis either on their own, or from others.

Because promotion and learning are two alternative sources of information, they may either substitute for one another, or be complementary. These results support the latter as the returns to Fuji-specific promotion are uniformly higher when both cumulative consumption and Fuji-specific promotion are considered together. By including the effect of cumulative consumption, this simulation takes into account any stage-of-life-cycle effects that may exist. Although a benefit:cost ratio cannot be calculated as directly for cumulative consumption as for the other programs, money spent on providing store samples can be thought of as initiating consumption habits. At current promotion expenditure levels, this means that an incremental dollar expenditure on Fuji promotion leads to $6.33 of producer surplus, while an additional dollar of spending on store-samples causes producer surplus to rise by only $0.84. This result suggests that samples are an inefficient way to generate new producer surplus, due perhaps to the fact that apples are seasonal and their quality is highly variable so that knowledge gained from one sample may be a poor indicator of the attributes of future purchases.

Conclusions and Implications for Future Research

In general, this study finds positive rates of return to Fuji apple growers' variety-specific promotional investments, but negative returns to generic programs. Although these rates of return are superior to returns on other investments available to growers, they are consistent with the returns to promoting other produce items (Alston et al.). This study not only adds to a growing body of evidence demonstrating the effectiveness of cooperative grower-promotion programs, but considers issues that have not been explicitly addressed in other studies of this type. Namely, it compares the relative effectiveness of variety-specific promotion, generic or product-promotion, and consumer experience in generating producer surplus.

Returns to each of these factors are estimated with a market-simulation model of producer surplus, incorporating demand elasticities from a two-stage LES/LAIDS model of variety demand, and transmission elasticities taken from dynamic empirical models of the retail-farm price linkage. With this model, the return to Fuji-specific promotion is generally positive over a variety of parametric assumptions. Generating over $6.00 of producer surplus for a $1.00 investment in promotion, such targeted expenditures appear to be a much more effective use of growers' checkoff money than generic promotion. In fact, generic promotion generates less than the cost incurred, so returns are uniformly negative. The highest returns are obtained when Fuji-specific promotion and consumer experience are considered together, due to the complementary effects between learning and promotion in increasing demand. Despite these positive findings, some caveats and limitations must be kept in mind.

First, this study shows that the returns to Fuji promotion were lower during the intensive "Year of the Fuji" campaign (1997) compared to the entire sample. While benefit:cost ratios in excess of $5.00 are common over the entire sample period, returns fall by an average of 40% during the Fuji campaign. Although this may be due to the fact that a "normalization" of Fuji prices was required in order to move a crop that was more than double the previous year's, it may also be due to the diminishing marginal returns of commodity promotion. These lower returns may also be simply due to Fuji's maturation as a product as the primary constraint to increased sales may be a lack of experiential knowledge of Fujis' taste, texture, and storability. Traditional methods of promotion can help in removing this obstacle, but are not perfect substitutes. Consequently, promotion may become more effective over time as consumers learn about Fujis on their own or by word of mouth. Second, aggregate data provide only approximate measures of the actual variables required to measure the return to promotion. As such, these data do not contain information on differences among advertising media, nor the total amount of exposure generated by each dollar of expenditure.

References

Alston, J.M., J.A. Chalfant, J.E. Christian, E. Meng, and N.E. Piggott. 1996. "The California Table Commission's Promotion Program: An Evaluation." Department of Agricultural Economics, University of California, Davis. Davis, CA.

Anderson, R.W. 1979. "Perfect Price Aggregation and Empirical Demand Analysis." *Econometrica* 47:1209–30.

Blackorby, C., R. Boyce, and R. Russel. 1978. "Estimation of Demand System Generated by the Gorman Polar Form: A Generalization of the S-Branch Utility Tree." *Econometrica* 46:345–63.

Brester, G.W., and T.C. Schroeder. 1995. "The Impacts of Brand and Generic Advertising on Meat Demand." *Amer. J. Agr. Econ.* 77:969–979 (November).

Brown, M., and D. Heien. 1970. "The S-Branch Utility Tree: A Generalization of the Linear Expenditure System" *Econometrica* 40:737–47.

Chang, H.S. 1988. "Measuring the Effects of Advertising in Food Demand Subsystems." Ph.D. Dissertation, Dept. of Agricultural Economics, U. of California-Davis.

Chang, H.S., and R. Green. 1989. "The Effects of Advertising on Food Demand Elasticities." *Can. J. Agr. Econ.* 37:481–94.

Cox, T. 1992. "A Rotterdam Model Incorporating Advertising Effects: The Case of Canadian Fats and Oils." in *Commodity Advertising and Promotion.* H.W. Kinnucan, S.R. Thompson, and H.S. Chang, eds. Ames: Iowa State Press.

Cox, T.L., and M.K. Wohlgenant. 1986. "Prices and Quality Effects in Cross-Sectional Demand Analysis." *American Journal of Agricultural Economics* 68:908–919.

Day, G.S. 1981. "The Product Life Cycle: Analysis and Applications Issues." *Journal of Marketing* 45:60–67.

Deaton, A., and J. Muellbauer. 1980. *Economics and Consumer Behavior.* Cambridge, U.K.: Cambridge University Press.

Duffy, M.H. 1991. "Advertising in Demand Systems: Testing a Galbraithian Hypothesis." *Applied Economics* 23:485–96.

Ehrlich, I., and L. Fisher. 1982. "The Derived Demand for Advertising: A Theoretical and Empirical Investigation." *American Economic Review* 72:366–388.

Erickson, G.M. 1985. "A Model of Advertising Competition." *J. Marketing Research* 22:297–304 (August).

Feichtinger, G., R.F. Hartl, and S. Sethi. 1994. "Dynamic Optimal Control Models in Advertising: Recent Developments." *Management Science* 40:195–226 (February).

Gao, X.M., E. Wailes, and G. Cramer. 1995. "A Microeconometric Model Analysis of U.S. Consumer Demand for Alcoholic Beverages." *Applied Economics* 27:59–69.

Gardner, B. 1975. "The Farm-Retail Price Spread in a Competitive Food Industry." *Amer. J. Agr. Econ.* 57:399–409.

Goddard, E.W., and P. Conboy. 1993. "Optimal International Promotion Expenditure for Differentiated Products." *Review of Marketing and Agricultural Economics.* 61:49–61.

Goldman, F., and M. Grossman. 1978. "The Demand for Pediatric Care: An Hedonic Approach." *J. Political Economy* 86:259–280.

Gorman, W.M. 1959. "Separable Utility and Aggregation." *Economica* 27:469–81.

Hausman, J. 1997. "Valuation of New Goods under Perfect and Imperfect Competition" in Bresnahan, T.F. and R.J. Gordon, eds. *The Economics of New Goods* National Bureau of Economic Research (NBER) Studies in Income and Wealth, vol. 58. Chicago and London: University of Chicago Press.

Heien, D.M. 1980. "Markup Pricing in a Dynamic Model of the Food Industry." *American Journal of Agricultural Economics* 62:10.

Hoffman, D.L. 1987. "Two-Step Generalized Least Squares Estimators in Multi-Equation Generated Regressor Models." *Review of Economics and Statistics* 69:336–346 (May).

Kinnucan, H.W. 1997. "Middlemen Behaviour and Generic Advertising Rents in Competitive Interrelated Industries." *Australian Journal of Agricultural and Resource Economics* 41:199–207.

Kinnucan, H.W., and O.D. Forker. 1987. "Asymmetry in Farm-Retail Price Transmission for Major Dairy Products." *American Journal of Agricultural Economics* 69:285.

Kinnucan, H.W., Xiao, H., and J.C. Hsia. 1995. "Direct and Spillover Effects of Increased U.S. Beef Promotion." in *Economic Analysis of Meat Promotion* Proceedings from the NEC-63 Conference, Denver, CO. pp. 81–96 (June).

Kinnucan, H.W. 1999. "Advertising Traded Goods." *Journal of Agricultural and Resource Economics* 24:38–56 (July).

Kotler, P. 1965. "Competitive Strategies for New Product Marketing over the Product Life Cycle." *Management Science* 12:b104–119 (December).

McFadden, D.L., and K.E. Train. 1996. "Consumers' Evaluation of New Products: Learning from Self and Others." *Journal of Political Economy* 104(4):683–703.

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

Muth, R.E. 1965. "Derived Demand Curve for a Productive Factor and the Industry Supply Curve." *Oxford Economic Papers* 16:221–234.

Nelson, P. 1974. "Advertising as Information." *Journal of Political Economy* 82:729–54 (July/August).

Nerlove, M., and K.J. Arrow. 1962. "Optimal Advertising Policy Under Dynamic Conditions." *Economica* 29:129: 142.

Parker, D.D., and D. Zilberman. 1993. "Hedonic Estimation of Quality Factors Affecting the Farm-Retail Margin." *Amer. J. Agr. Econ.* 75:458–466 (May).

Pollak, R.A., and T.J. Wales. 1981. "Demographic Variables in Demand Analysis." *Econometrica* 49:1533–51.

Powers, N.J. 1991. "Marketing Order Impacts on Farm-Retail

Price Spreads." *American Journal of Agricultural Economics* 73:507–510.

Powers, N.J. 1995. "Sticky Short-Run Prices and Vertical Pricing: Evidence from the Market for Iceberg Lettuce." *Agribusiness* 11:57–75.

Schroeter, J.R., and A. Azzam. 1991. "Marketing Margins, Market Power, and Price Uncertainty." *American Journal of Agricultural Econimics* 73:990–999.

Sexton, R.J. 1990. "Imperfect Competition in Agricultural Markets and the Role of Cooperatives: A Spatial Analysis." *American Journal of Agricultural Economics* 72:709–720.

Shonkwiler, J.S., and T.G Taylor. 1988. "Food Processor Price Behavior: Firm-Level Evidence of Sticky Prices." *American Journal of Agricultural Economics* 70:239–243 (May).

Sorger, G. 1989. "Competitive Dynamic Advertising: A Modification of the Case Game." *J. Economic Dynamics and Control* 13:55–80.

United Nations. 1993. *Commodity Trade Statistics.*

United States Department of Labor, Bureau of Labor Statistics. 1997. *Consumer Price Index: Average Price Data.* http://stats.bls.gov:80/cgi-bin/dsrv?ap.

United States Department of Labor, Bureau of Labor Statistics. 1997. *Employment and Earnings: State and Area.* http://stats.bls.gov:80/cgi-bin/dsrv?sa.

United States Department of Energy, Energy Information Administration. 1995–1997. *Monthly Energy Review,* various issues.

United States Department of Commerce, Bureau of Economic Analysis. 1997. *Regional Programs.* http://www.bea/doc.gov/bea/dr/spitbl-d.htm.

United States Deparmtent of Commerce, Bureau of Census. 1997. *State Population Estimates.* http://www.census.gov/population/estimates/state.

Ward, R.W. 1982. "Asymmetry in Retail, Wholesale, and Shipping Point Pricing for Fresh Vegetables." *American Journal of Agricultural Economics* 64:205.

Ward, R.W. 1993. "Washington Apple Advertising: An Update." Washington Apple Commission Report No. 93#1. Wenatchee, WA. (June).

Washington Apple Commission. 1995–1997a. *Market Vu Report* Wenatchee, WA. various issues.

Washington Apple Commission. 1995–1997b. *Unloads Report* Wenatchee, WA. various issues.

Washington Apple Commission/Leemis Market Research. 1995–1997c. *Ad Activity* Wenatchee, WA. various issues.

Yen, T.Y., and T.L. Roe. 1989. "Estimation of a Two-Level Demand System With Limited Dependent Variables." *Amer. J. Agr. Econ.* 71:85–99.