New Varieties and the Returns to Commodity Promotion:

Washington Fuji Apples

by

Timothy J. Richards and Paul M. Patterson

---

1 Paper Presented at AAEA Annual Meeting, Salt Lake City, UT. August 1998. Authors are Assistant Professors, Morrison School of Agribusiness, and National Food and Agriculture Policy Project, Arizona State University East, Mesa, Arizona. Copyright 1998 by Timothy J. Richards. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies. Support from the Washington Apple Commission is gratefully acknowledged.
Abstract

Demand for a new fruit variety depends upon variety-specific promotion, generic promotion, and accumulated experiential knowledge. A two-stage model estimates the relative effect of each variable on Fuji apple demand. An equilibrium displacement model calculates the rate of grower-return to each. Results show that Fuji-specific promotion yields a base-scenario benefit:cost ratio of 14.73.

**keywords:** apple demand, experience, LAIDS, new products, producer surplus, promotion, varieties.
Introduction

Developed in Japan in 1958, growers in Washington state began growing Fuji apples in 1990. With nearly 11,000 bearing acres, Fujis now represent the third largest variety in terms of acreage in the state, surpassing even the Granny Smith. Faced with marketing production that has increased from virtually nothing 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, through the Washington Apple Commission (WAC), recognize the need for a Fuji-specific promotional campaign. Much of this advertising seeks to capitalize on the unique attributes of Fujis: their sweet flavor, crisp texture, and attractive coloring. A 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 that this type of program 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. However, there is some question of the viability of variety-specific promotion when quality from year-to-year is difficult to control, when many producers sell the same variety, and given evidence in the trade-press indicating that consumers are not likely to consider variety in their apple choice (The Packer, 1996). Like most fruits and vegetables, apples are experience goods so purely informative advertising, whether generic or variety-specific, may not be as effective as promotion designed to induce trial purchases. Once consumers buy a certain type of apple, their experience and word-of-mouth may be enough to establish a market for the variety. As a result, growers are justifiably concerned over the economic viability of promoting Fujis.

Therefore, the objective of this research is to determine the return to Washington apple growers’ investments in generic and variety-specific promotion. In order to determine grower
returns, this paper first develops a model of the Washington apple market used to calculate the incremental producer surplus resulting from each type of promotion. The next section describes a two-stage model of Fuji demand that estimates the effect on demand of advertising and consumers’ accumulated experience with Fujis. This section also describes an empirical model of Fuji FOB-price determination that is used to calculate the price-transmission elasticity. A fourth section presents the results from each stage of the analysis, while the final section summarizes these results and presents some implications, limitations, and suggestions for future research.

A Conceptual Model of Washington Apple Promotion

For the purposes of this study, 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. The model used to calculate incremental producer surplus assumes that a change in promotion spending first causes a change in demand at the retail level to an extent measured by the promotion-response elasticity. Second, the change in FOB price in response to this change in demand is determined by the price-transmission elasticity. Third, once filtered down to the FOB level, 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. Ultimately, changes in producer surplus are found using a simplified version of the Muth Equilibrium Displacement (MED) model described by Kinnucan et al. This model expresses equations for retail demand, export demand, FOB price, and farm supply in log-differential form and, using these equations, solves for the change in producer surplus resulting from changes in the exogenous variables in the model. 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 benefit:cost ratio. Clearly, the key parameters in this model are those that measure the sensitivity of demand to each type of promotion and consumer-learning.

A Two-Stage Model of Fuji Demand and Promotion
A two-stage model of demand captures the effect of promotion on both total apple sales and the share of each variety. 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. Many studies of commodity promotion also use this approach to differentiate between first- and second-stage promotion effects (Goddard and Tielu, Goddard and Amuah, Richards, van Ispelen and Kagan).

Modeling the entire budgeting decision as a multi-stage process has many advantages over the alternative in that it allows for the specification of a more complete demand system, does not suffer from specification errors caused by considering each stage in isolation, and permits nested tests of the generic and variety effects of promotion. However, these advantages come 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. 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 means that the price indices at the upper level are perfect price indices for each sub-group, so estimating the entire system through Anderson’s iterative process 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). Both of these demand representations are well known, so their derivations are not reproduced here. Each stage incorporates a stock of promotion variable using the scaling technique of Pollak and Wales. Essentially, scaling deflates prices by a function of exogenous variables hypothesized to affect demand. Applying this method to the first-stage demand model leads to:
\[ X_i = P_i Q_i = P_i \Psi_i + \theta_i \Psi A_i^* + B_i \left( Y - \sum_j \Psi_j P_j \right). \]  

(1)

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 \( I \), \( A_i^* \) is a stock of generic advertising, \( B_i \) is the marginal budget share, and \( \Psi_i \) measures the subsistence amount of expenditure on good \( I \). For this equation to be part of a system of demand equations that is consistent with constrained utility maximization, all \( B_i \geq 0 \), \( \sum B_i = 1 \), and \( Q_i \geq \Psi_i \forall I \). Defining advertising as a capital asset (Nerlove and Waugh; Ehrlich and Fisher) implies that the current amount of \( A_i^* \) is a distributed lag of previous investments: \( A_i^* = \sum_i b(i) A_{t-i} \), where \( b(i) \) are lag-weights. Similar considerations for promotion carryover enter the second-stage model.

At the second, or variety-demand stage, a linear Almost Ideal Demand System (LAIDS) satisfies the requirement for two-stage budgeting in that the implied preferences are of Gorman polar form (Deaton and Muellbauer). Including promotion stocks in this model leads to a share system of the form:

\[ w_i = \alpha_i + \sum_j \gamma_{ij} \ln p_j - \sum_j \gamma_{ij} \delta_j \ln A_j^* + \beta_i \ln (X_A/P_A), \]  

(2)

where \( w_i \) is the share of variety \( i \) \( (p_i q_i/X_A) \); \( p_i \) is the price of variety \( i \); \( X_A \) is the amount of expenditure on the \( A \) commodity sub-group, and \( \ln P_A \) is a Stone price index for this group such that \( \ln P_A = \sum_i w_i \ln p_i \) and \( A_j^* \) is a vector of variety-specific promotion stocks. Baye, Jansen, and Lee describe the usual set of parametric restrictions to ensure symmetry, homogeneity, and adding-up extended to include scaling.

Consumers, however, also obtain product knowledge from sources other than advertising. Particularly for new varieties of a mature product, such knowledge can be acquired by search or
experience (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 (Lilien and Kotler). 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 experiential information is likely to have different effects on the demand for mature and new varieties.

Experience is incorporated into the demand model by allowing each share intercept to vary with cumulative consumption: $$\alpha_i = \alpha_{0i} + \alpha_{1i} \sum_{t=0}^{T} Q_t$$. 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 elasticities of variety sales with respect to prices and promotion that take into account both the category and variety response. These elasticities are similar to those reported in Richards, Van Ispelen and Kagan. Changes in producer surplus, however, also depend upon the FOB 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 FOB and retail prices include labor and transportation costs, export-market price premiums, or the premium initially due to Fujis’ status as a new variety in relatively limited supply. Further, differences between retail and orchard prices may arise if there are lags in the adjustment of FOB prices to changes in retail demand. Adapting the relative price spread model (Wohlgenant and Mullen) to include these considerations provides a means of estimating transmission elasticities. Defining $$\epsilon_d$$ as the retail elasticity of demand for Fujis; $$\epsilon_e$$ as the elasticity of export demand with respect to the FOB price, $$\epsilon$$; as the elasticity of demand for other; mature apple varieties; $$\theta_1$$ as the conjectural variation of export demand with respect to retail demand $$(dq^x / dq^r)$$; $$\theta_o$$ as the conjectural variation of mature variety
sales with respect to Fuji retail sales, and allowing for the sluggish adjustment of retail prices to changes at the wholesale level (Heien, Ward, 1982, Kinnucan and Forker, Powers, 1995) and writing in estimable form leads to:

\[ p_t^f = \alpha_o + \alpha_1 p_{t-1}^f + \alpha_2 p_t^r + \alpha_3 \left( \frac{q_x}{q_t} \right) + \alpha_4 \left( \frac{q_o}{q_t} \right) + \alpha_5 \left( w \right) + e_t, \]  

\[ (3) \]

which is estimated for each market using independent instrumental-variable regressions to account for the likely endogeneity of the right-side quantity variables. In (3), \( q^r \) is the retail quantity; \( q^e \) is the quantity sold for export; \( q^o \) is the quantity of other varieties sold, \( p^r \) is the retail price; \( p^f \) is the FOB price; \( k \) is a constant of proportionality representing shrinkage and loss from the orchard to the store, and \( w \) is a vector of input prices. 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 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 market-shipments, respectively. 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. Prices in each market are adjusted for variations in grade, package, size, source, and appearance using a hedonic method similar to Goldman and Grossman or Cox and Wohlgenant. Shipment data from the Unloads report are defined on a zip code basis, so 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. 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, and specify periods over which the activity may occur. Another data source, the Ad Activity Report, prepared by Leemis Market Research, reports the 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 data prepared for the WAC by McCann-Erickson. These sources provide data series for both total Fuji promotion expenditures and for expenditures on all other apples.

These price, quantity, and promotion data are used in both a variety-level demand model, and aggregated for use in the first-stage, or category-level demand model. 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 FOB price 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, instrumental variable regressions. Estimating the LES/LAIDS demand model employs the iterative algorithm described by Anderson to ensure that the aggregate price index remains consistent with the two-stage
budgeting assumption. Each stage of this process uses an iterative seemingly unrelated regression (ITSUR) procedure. Stocks of each type of promotion are calculated using the quadratic exponential lag model described by Cox or Brester and Schroeder. Finally, because changes in producer surplus are likely to be dependent upon the elasticity estimates particular to this sample, sensitivity analysis over growers’ share of the retail dollar, the elasticity of supply from apple shippers, and the retail elasticity of demand are conducted and reported in table 1. Because growers and WAC officials alike are interested in the effectiveness of the “Year of the Fuji” campaign in particular (1997), simulations for each parameter regime are conducted for the entire sample and for only the 1997 observations. Further, the simulation results reported in the next section 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%.

Results and Discussion

The primary concern of this paper is with returns to promotion, so the discussion focuses on these results. The results from all other parts of the analysis are available from the authors. 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 benefits to the change in 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 1.

In the base scenario, a 10% rise in Fuji promotion generates a benefit:cost ratio (BC) of 14.73 for the entire sample period, but falls to 8.59 for the “Year of the Fuji” campaign. This
reduction in returns over the later period may be due to declining marginal returns to promotion, or to the increasing relative importance of consumer experience compared to promotion. Nonetheless, the returns to promotion are still strongly positive and many times their cost of provision under all alternative parameter assumptions. However, these results do appear to be sensitive to other parameters in the simulation model.

In particular, as expected, returns over the entire sample rises to 21.53 if growers receive 80% of the retail dollar, but falls to 12.57 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. Perhaps the most important simulation considers different elasticities of supply from shippers. If supply is inelastic, or nearly fixed (0.5), the return to promotion rises to 26.71 from the base case. In this case, any increase in demand will cause FOB prices to rise significantly, while causing little change in quantity supplied. On the other hand, a supply elasticity more than double that considered in the base scenario (3.0) causes the returns to promotion to fall to 8.66, as growers respond to higher prices by increasing the quantity supplied more than proportionately. Further, variety-specific promotion becomes more effective the lower the elasticity of demand. In fact, reducing the demand elasticity to levels closer to the mature varieties provides a BC estimate of $23.05 for the next dollar invested. Qualitatively, these conclusions hold for each of the other combinations of promotion and experience, but the net returns differ considerably.

In particular, the BC ratio for a 10% rise in total WAC promotion is less than one in the base case, for both the entire sample and the “Year of the Fuji.” BC ratios less than 1.0 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. Unlike the case for Fuji-specific promotion, the return to total WAC, or generic, promotion is higher during the “Year of the Fuji”
campaign than over the full sample. This suggests that there were greater synergies between the two types of promotion when Fujis were being promoted aggressively.

Because promotion and learning are two alternative sources of information, there is a potential that they may substitute for one another. However, it may also be the case that promotion in fact reinforces learning and vice versa. This indeed appears to be true as the returns to Fuji-specific promotion, when allowing for the accumulation of experiential knowledge through consumption, are uniformly higher than when Fuji-specific promotion is considered alone. In fact, table 1 shows that the return to Fuji-specific promotion in this scenario may be as high as $30.21 for the next dollar invested if demand is inelastic (-0.5) or $35.51 if supply is inelastic. The most conservative estimate of returns arises when shipper supply is highly elastic, but still provides a margin return of $11.28 for the next dollar of promotion. Under the base-scenario, Fuji-specific promotion returns $19.27 per dollar of promotion for the entire sample, and $11.25 per dollar for the “Year of the Fuji” campaign. Finding a significant difference in returns between the two time periods provides more support for the argument that there are declining marginal returns to promotion.

**Conclusions and Implications for Future Research**

In general, this study finds very high rates of return to Fuji apple growers’ promotional investments. 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 Fuji-specific promotion is uniformly positive over a variety of parametric assumptions. Generating almost $15.00 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 returns less than a dollar in producer surplus for each dollar in costs to Fuji apple growers. The highest returns are obtained when Fuji-specific promotion and consumer experience are considered together, due the complementary effects between learning and promotion in increasing demand. Despite these positive findings, returns to promotion during the intensive “Year of the Fuji” campaign are far lower. 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. As a new product, the primary constraint to increased sales may be a lack of experiential knowledge of the product’s 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 a new variety on their own or by word of mouth.
References


# Table 1. Grower Returns to Fuji and WAC Promotion Expenditure: November 1995 - May 1997

<table>
<thead>
<tr>
<th></th>
<th>Fuji Promo</th>
<th>All WAC Promo</th>
<th>Fuji Cumulative</th>
<th>Fuji Promo &amp; Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Entire Sample</td>
<td>Year of the Fuji</td>
<td>Entire Sample</td>
<td>Year of the Fuji</td>
</tr>
<tr>
<td><strong>Change in Producer Surplus</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Base Case</strong>¹</td>
<td>977.1</td>
<td>567.7</td>
<td>339.8</td>
<td>197.4</td>
</tr>
<tr>
<td><strong>High Farm Share</strong></td>
<td>1428.7</td>
<td>830.1</td>
<td>496.9</td>
<td>288.7</td>
</tr>
<tr>
<td><strong>Low Farm Share</strong></td>
<td>714.3</td>
<td>415.1</td>
<td>248.5</td>
<td>144.4</td>
</tr>
<tr>
<td><strong>High Supply Elasticity</strong></td>
<td>574.3</td>
<td>333.7</td>
<td>125.3</td>
<td>72.8</td>
</tr>
<tr>
<td><strong>Low Supply Elasticity</strong></td>
<td>1772.3</td>
<td>1029.7</td>
<td>430.2</td>
<td>249.9</td>
</tr>
<tr>
<td><strong>High Demand Elasticity</strong></td>
<td>617.7</td>
<td>358.9</td>
<td>215.2</td>
<td>125</td>
</tr>
<tr>
<td><strong>Low Demand Elasticity</strong></td>
<td>1529.2</td>
<td>888.5</td>
<td>530.5</td>
<td>308.3</td>
</tr>
<tr>
<td><strong>Benefit/Cost Ratio</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Base Case</strong></td>
<td>14.73</td>
<td>8.59</td>
<td>0.23</td>
<td>0.37</td>
</tr>
<tr>
<td><strong>High Farm Share</strong></td>
<td>21.53</td>
<td>12.57</td>
<td>0.34</td>
<td>0.55</td>
</tr>
<tr>
<td><strong>Low Farm Share</strong></td>
<td>10.77</td>
<td>6.28</td>
<td>0.17</td>
<td>0.27</td>
</tr>
<tr>
<td><strong>High Supply Elasticity</strong></td>
<td>8.66</td>
<td>5.05</td>
<td>0.09</td>
<td>0.14</td>
</tr>
<tr>
<td><strong>Low Supply Elasticity</strong></td>
<td>26.71</td>
<td>15.59</td>
<td>0.29</td>
<td>0.47</td>
</tr>
<tr>
<td><strong>High Demand Elasticity</strong></td>
<td>9.31</td>
<td>5.43</td>
<td>0.15</td>
<td>0.24</td>
</tr>
<tr>
<td><strong>Low Demand Elasticity</strong></td>
<td>23.05</td>
<td>13.45</td>
<td>0.36</td>
<td>0.58</td>
</tr>
</tbody>
</table>

¹ 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 = 3.0, Low Supply Elasticity = 0.5; Base Demand Elasticity = -1.266, High Demand Elasticity = -2.5, Low Demand Elasticity = -0.5. N.A. means that the measure is not applicable.