Agricultural Commodity Promotion Policies and Programs in the Global Agri-Food System

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Part Two:

Case Studies of Market Promotion Effectiveness

Walnuts in Japan: A Case Study of Generic Promotion Under the USDA's Market Promotion Program

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Introduction

The decision of the California walnut industry to mount a campaign aimed at dramatically increasing shipments of walnuts to Japan provides a classic case study of generic market development activities conducted by a marketing order commodity with funds from the Market Promotion Program (MPP). This paper examines, from an empirical point of view, whether or not these market development activities by the walnut industry, with the support of the MPP, have been successful. Sophisticated techniques based on time series analysis, specifically intervention analysis and transfer function model specification procedures, are combined with a unique high-frequency data set to determine the form and magnitude of the linkages between advertising and sales. Monthly data (since 1976) on walnut shipments to Japan and advertising placements are employed to analyze the effects of promotional expenditures on export shipments. The new methodology substitutes data -- monthly shipments and monthly placement of advertising -- for the functional form and demand theory restrictions traditionally employed to assess advertising effectiveness. The goal is to closely link in time the actual campaign presence in the market to the shipment response, in contrast to studies that assume particular utility functions and necessarily operate at a more aggregate level using annual budgeted advertising expenditures.

A rigorous empirical assessment of generic advertising effectiveness is in order since tight budgets coupled with an increasingly disillusioned *body politic*

have led to a close scrutiny of all federal and state agricultural expenditures. Not the least controversial is the Market Promotion Program (formerly known as the Targeted Export Assistance program, and currently as the Market Access Program) which has withstood fierce attacks from some members of Congress and the popular press. At issue is whether the U.S. government (and taxpayers) should help support the export of specific commodities where individual firms benefit. In October of 1992 strong criticism was leveled against the MPP program when it was publicly disclosed that several large corporate participants had been awarded large amounts of program funds; among others, the wealthy Gallo family received $10 million in public funds for private promotion of wine over several years. Furthermore, as a corollary, many researchers question the effectiveness of generic promotion activities in general. More recently Congress cut back to $90 million annually from $200 million in 1992.

Five arguments are usually made in favor of market research and development expenditures. First, the promotion programs affect consumer demands and shift the demand outward at every price, resulting in higher sales. Second, with a few exceptions like the MPP which receives matching taxpayer dollars, the promotion efforts are funded primarily by the producers and handlers. Third, generic advertising can benefit all producers within an industry as opposed to many branded advertising efforts which are susceptible to free-riders. Fourth, programs like the MPP aid smaller producers who cannot overcome the large advertising and promotion costs. Finally, consumers can receive some benefits from the information provided through promotion campaigns, *e.g.*, the effective use of walnuts in a diet can lower the chances of heart disease.

The counter arguments are as follows. First, the resources devoted to market development activities may be better used in alternative ways. Second, shifts in consumer demand are very small and temporary at best. Third, taxpayer

funds should not be used to promote specific goods, subsidize large corporations, or aid American business in other countries. Furthermore, there is no evidence that producers and/or handlers would not fully fund the promotional efforts if taxpayer support were withdrawn. Fourth, generic advertising is not as effective as a branded campaign. Fifth, promotion funds might more effectively be spent on reducing production costs rather than in an effort to shift the demand curve. Last, why fund the promotion of one commodity, say almonds, which might lead consumers to substitute away from a competing commodity like walnuts which might also be promoted by generic advertising expenditures?

The predecessor of the MPP, the TEA, was authorized in the 1985 farm bill. Its provisions support specific commodities that are attempting to enter or increase exports into foreign countries where institutional or governmental policies prevent U.S. products from competing on the proverbial "level playing field." Grower/producer groups can acquire funding by applying to the U.S. Department of Agriculture. Since advertising and other promotional activities are an important and significant expenditure for most federal and state marketing orders, boards or commissions, mandatory assessments ("checkoff" programs) provide the bulk of the cooperator's funding. The fees are assessed at the first handler level or at the point of sale.

Specific to this program, the lucrative Japanese market accounts for 20 percent of U.S. agricultural exports ($46.7 billion in 1993); walnut producers exported in excess of $40 million during 1995. (More than 99 percent of U.S. commercial production occurs within the state of California.) Figure 1 depicts the exponential growth of walnut exports to Japan. As can be seen, walnut shipments increased from under 500 metric tons to over 5,000 tons in an eight-year period, an almost six-fold increase.

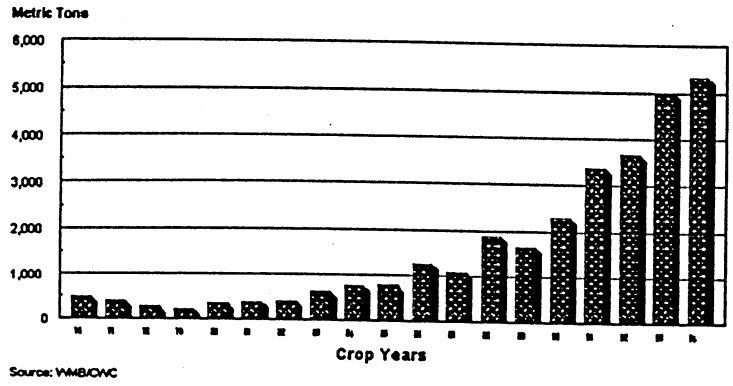

Figure 1 ***Walnut Shipments to Japan/Shelled, 1976-Present***

A portion of promotion efforts was geared to the consumer and the balance was targeted at industrial users. Specifically, the market development activities include consumer advertising, public relations, consumer promotions, trade presentations, trade advertising, trade fairs, technical seminars, menu promotions, a school lunch program, hotel promotions, and new product development competitions. The majority of funding for market development and promotion proceeds from two sources: growers and government agencies. For most commodities including walnuts, growers contribute a small (self-assessed) fee per pound and, combined with more restrictive USDA funds, support promotion activities.[1] As can be seen from Table 1, a large proportion of walnut MPP funds were directed toward the Japanese market.

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[1]For example, in California during the 1988-1989 fiscal year, marketing orders collected over $150 million from producers. Of this amount $115 million was spent on market promotion and development, some under California programs and some under federal programs. Specific examples include $19.7 million for milk, $19 million on raisins, $14.9 million for almonds, $8.6 million on walnuts, $7.6 million for prunes, $7 million for avocados, $5.9 million on table grapes, $4.5 million for eggs, and $2.9 million for strawberries. Numerous other commodities have expenditures which total less than $1 million.

Table 1: MPP and Industry Promotion Expenditures for U.S. Walnuts.

	Total (all targeted markets)	Japan
	(Thousands of US$)	(Thousands of US$)
1986-87	8,179	5,485
1987-88	5,877	3,300
1988-89	6,094	3,050
1989-90	7,401	2,300
1990-91	8,544	2,445
1991-92	8,189	2,800
1992-93	6,425	2,300
1993-94	5,080	1,850
1994-95	3,500	1,665
1995-96	3,000	1,801

Source: California Walnut Commission

Related Work

Over the years, a staggering amount of effort has been directed toward assessing advertising effectiveness. Berndt (1991) provides a concise summary of economic advertising models. He discusses several econometric issues that are found in advertising specifications. They include: (1) measurement of advertising messages and their prices; (2) issues of simultaneity between advertising and sales

(Schoenberg [1933], Borden [1942], Telser [1962], Palda [1964]); and Granger causality (Pierce and Haugh [1977], Schmalensee [1980]); (3) alternative distributed lag models accounting for the cumulative impact of advertising efforts (Clarke and McCann [1973]); and (4) issues of aggregation over time (Clarke [1976], Theil [1954], Zellner and Montmarquette [1971], Bass and Leone [1983], Weinberg and Weiss [1982]).

Berndt also includes a summary of some of the more popular advertising models employed by economists. Three of the models are the lingering effects model, current effects model, and the brand loyalty model. In the lingering effects model, current sales depend on current advertising, lagged sales, and a moving average disturbance. The current effects model is based on the notion that only current advertising has an impact on sales. The brand loyalty specification removes the lingering effects justification for lagged sales. Instead, lagged sales are motivated by invoking a geometric decay hypothesis of advertising to capture marketing carryover effects that are more general than solely advertising. All of these alternative model specifications differ econometrically in that they produce different error structures.

The economic framework for advertising within the structure of a profit maximizing firm has been developed by Buchanan (1942), Kaldor (1950, 1951), Rasmussen (1952), Dorfman and Steiner (1954), Nerlove and Arrow (1962), and Tesler (1966). Schmalensee (1972, 1978) explores advertising under Cournot and Bertrand oligopolies. On the consumer side, the utility function can contain a vector of information which includes advertising and can thus be viewed as being "consumption augmenting." This theory was advanced by Basmann (1956), Fisher and Shell (1968), Schmalensee (1972), Massy (1960), and Rosen (1980). Another important paper which integrated advertising demand into a theoretical framework was authored by Verma (1980). Within the realm of agricultural economics,

research by Nerlove and Waugh (1961) looks at the cumulative effects of advertising on the demand for oranges.

There is an extensive literature on measuring the effects of generic advertising on the sales of agricultural commodities. These studies have been complicated by the lack of quality disaggregated advertising data and the difficulty in modeling delayed advertising effects over time. Significant research has been conducted by members of the Northeastern Committee-63 (Agricultural Advertising) advertising and promotion research group, see for example Forker and Ward, Ward, Nichols *et al.*, and Kinnucan and Forker. Recent works by Lenz (1991), Forker (1991), and others have explored some commodity advertising in specific markets. Some of the issues addressed by researchers in the NEC-63 group are (1) selection of specifications to model advertising effects, (2) methods of incorporating advertising into demand systems, (3) examination of cross-advertising effects, (4) investigation of the proper lag structures to capture delayed advertising effects, (5) incorporation of demographic as well as advertising factors into demand systems, and (6) deflation of advertising expenditures by various media indexes. Spatz (1989) looked at the market development programs for commodities governed by a marketing order. A recent study related to market promotion (funded by the California Dried Fruit Association) did not achieve conclusive results for lack of sufficiently detailed statistical data. A 1991 report by the NEC-63, edited by Nichols, Kinnucan, and Ackerman, calls for increased research on the effectiveness of market promotion among commodities governed by marketing orders.

Numerous studies have examined market development and advertising of agricultural commodities (Green, *et al.*, Blaylock, Nerlove and Waugh, Ward *et al.*). A survey of the literature suggests that most promotion programs are effective; however, the degree has been difficult to measure due to a lack of good

data and due to test markets where price and income effects completely overwhelm any shifts due to advertising. The short run impacts of a promotion campaign usually result in higher sales and a higher market price. Whether this increase in demand justifies expenditure hinges on the length of time an advertising impulse affects its intended audience, *i.e.,* if demand initially shifts outward and then returns to its original equilibrium over time, the length and shape of the lagged advertising effect determines its effectiveness. A long-lasting or even permanent demand shift can provide benefits to producers, consumers, and society.

An Event Study Approach to Measuring the Effects of Market Development Expenditures

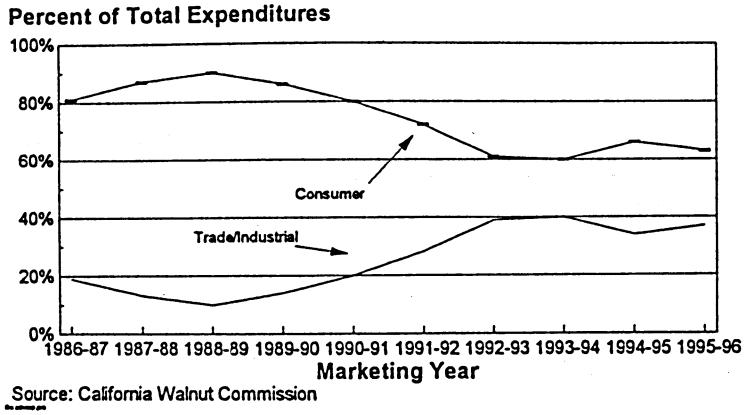
This case study of the walnut industry's market development program in Japan is ideal for several reasons: (a) accurate statistical information is available preceding and following the promotion efforts; (b) the promotion efforts and subsequent growth occurred in a relatively isolated environment without the usual multitude of external factors; © the Japanese market is representative of many developed-country markets in terms of incomes, education, and other socio-economic factors; and (d) promotional activities were nonexistent prior to 1986, providing for an *ex ante* and *ex post* advertising comparison. Japanese consumers are frequently described as "traditional" buyers--they purchase from the same grocer time after time, a fact that has obvious implications in terms of marketing and advertising mixes. Walnut prices within particular markets (*e.g.,* Tokyo, Kobe, Osaka, etc.) remain relatively constant throughout the year: competition among different supermarkets occurs not in prices, but rather in which chain has the higher quality products and best service. These factors allow easier isolation of the effects of advertising and promotions *vis a vis* the effects of relative price changes on consumer's purchasing decisions.

Data

The data are monthly observations on shelled and inshell shipments of walnuts from the United States to Japan, along with detailed information on market promotion and advertising activities conducted during the period of investigation. These data have been provided through the generous assistance of the Walnut Marketing Board and the California Walnut Commission. Data on expenditures, frequency and duration of each promotion effort, and the type of campaign will be utilized in the analysis. Information about the promotion efforts in Japan includes baking competitions targeted at the processor level, magazine and other forms of advertising targeted at consumers, and numerous other programs involving importers of walnuts into Japan. The monthly expenditures are determined by a calendar of events that delineates the specific activity and the intended target.

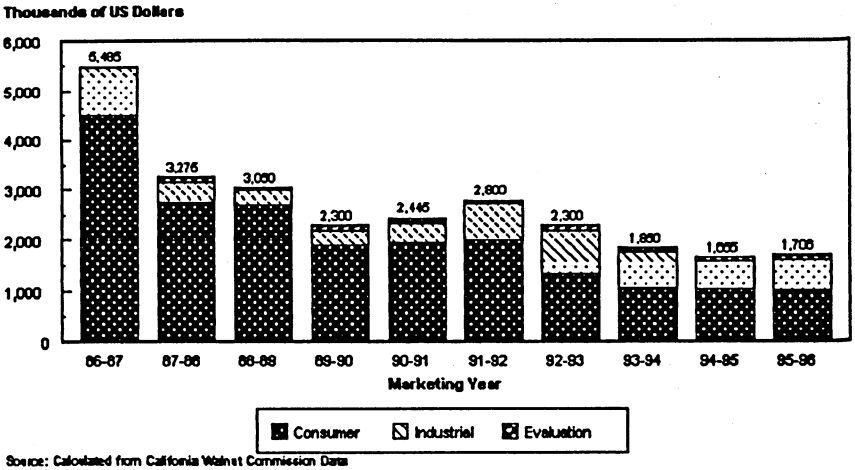
Members of the walnut industry in California are required to report monthly shipments of walnuts by destination. A small lag (two to three weeks) exists between the reported shipment date and the actual consumption by the consumer. Inshell shipments to Japan were the primary focus for promotion by the industry in 1986 but the emphasis turned out to be misplaced, and the promotion activities were quickly shifted away from inshell walnuts to the shelled product. Japan imported almost 11 million pounds of shelled walnuts during the 1994-95 season, and only 900,000 pounds of inshell product. Of the shelled product shipped abroad, three-fourths is used by industrial buyers as ingredients in breads, pastries, and other bakery products. Inshell walnuts, on the other hand, are utilized during special holidays and as part of gift packs.

Total expenditures on all market development activities since 1986 were approximately $26 million, of which $20.3 million (78 percent) were targeted at consumers and the balance (22 percent) at industrial/trade users. Figure 2 shows that the emphasis has recently shifted increasingly toward industrial users and away from consumers.



Source: California Walnut Commission

Figure 2 ***Marketing/Promotion Expenditures in Japan***



Source: Calculated from California Walnut Commission Data

Figure 3 ***Market Promotion Expenditures 1986 to present***

Figure 3 presents the total expenditures targeted at both consumers and the middlemen. Even as the number of applicants and cooperators has increased, overall allocation levels have been declining over the ten years of the program.

Market development activities targeted to the Japanese trade sector began at a high level and have declined slightly. The intent of the original expenditures was to interest members of the trade in establishing relationships with U.S. suppliers of walnuts. Since then, the goal has been to support the trade with technical information, fairs, and other activities conducive to imports. Industrial market development activities have been increasing significantly over the last decade. The early strategy of the marketing activities was to target retail consumers and create a "demand pull" environment for walnuts. With smaller budgets and increasing costs to reach final consumers, U.S. walnut producers and handlers focused greater attention on industrial users. Consumer market development activities have declined with a higher use of industrial product, increased media costs, and declining budgets. The U.S. walnut industry still maintains an active consumer program, but it is much more focused in its strategy, with a smaller reach than at the inception of the program.

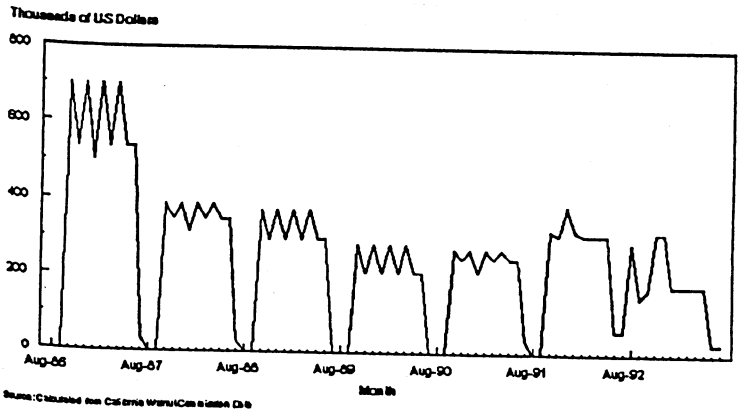


Figure 4 ***Total Advertising Expenditures 1986:8 to 1993:7***

Advertising expenditures are reported annually. They have been distributed into the appropriate months according to schedules provided by the California Walnut

Commission. The expenditure totals are divided across the periods to match the campaigns' presence in the market; actual expenditures reflect only billing dates. The lumpy and discrete nature of the campaigns makes the modeling problem extremely difficult, see Figure 4.

Intervention Analysis / Transfer Function Identification

A form of event study known as intervention analysis was introduced in an article by Box and Tiao (1975) where they discuss the effects of discrete policy changes on a response variable.[2] In their paper they examine *inter alia* the effects of opening the Golden State Freeway and the implementation of a new state emission law (Rule 63) on the average oxidant levels in downtown Los Angeles.

The Box-Tiao framework lends itself nicely to the analysis of the effects of market development activities (and advertising in particular) on sales. The available data $...y_{t-1}, y_t, y_{t+1}...$ can be modeled as

$$(1) \qquad y_t = f(\delta, x, \varepsilon) + N_t$$

where y_t denotes imports of walnuts, δ is a set of unknown parameters, x is a set of exogenous variables (market development activities), ε is a random error in the transfer function relation $f(.)$, and $N_t = y_t - f(\delta, x, t, \varepsilon)$ is an additive noise[3] process. The stochastic noise can, in turn, be modeled as an autoregressive moving average

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[2]Box, G. E. P. and G. C. Tiao, "Intervention Analysis with Applications to Economic and Environmental Problems," *Journal of the American Statistical Association*, 70(1975):70-79.

[3]"Noise" is a bit of a misnomer, since there are usually systematic components (as in any time series model) unrelated to advertising.

process relating N_t to the white noise error v_t

$$(2) \qquad \varphi(B)N_t = \delta_0 + \theta(B)v_t$$

where B is the backshift operator such that $By_t = y_{t-1}$, the autoregressive term $\varphi(B)=1-\varphi_1 B-\varphi_2 B^2-...-\varphi_p B$ of order p, the moving average term is $\theta(B)==1-\theta_1 B-\theta_2 B^2-...-\theta_p B^p$ of order q, and δ_0 is a constant term. The roots of the p degree autoregressive polynomial must lie on (an error shock has permanent effects, uncommon but possible) or outside the unit circle, and those of the q degree moving average polynomial must lie strictly outside the unit circle. Representing the dynamic model form with a rational distributed lag we have

(3)

$$f(\omega_1,\kappa_1,\omega_2,\kappa_2,x,\varepsilon) = \sum_{j=0}^{\infty}(\psi_{1j}x_{t-j}+\psi_{2j}\varepsilon_{t-j}) = \omega_1(B)/\kappa_1(B)x_t+\omega_2(B)/\kappa_2(B)$$

where δ previously contained κ_i and ω_i, i=1,2. Combining the dynamic model (3) and the stochastic noise model (2) gives the model to be identified and estimated,

$$(4) \quad y_t=f(\omega, \kappa, x, t, \varepsilon) + \delta_0+ \theta(B)/\phi(B)v_t = [\omega_1(B)/\kappa_1(B)x_t+\omega_2(B)/\kappa_2(B)\varepsilon_t] + \delta_0+ [\theta(B)/\varphi(B)]v_t.$$

Inputs can be broadly characterized as steps (movements to a new level) or pulses (one time shocks). As Box and Tiao show, the output response to either form of input can take various shapes, represented in (a) through (e) below. (A unit root in the autoregressive polynomial permits a steady state change in the response

variable from a one time pulse.) In the case of advertising or promotional activities, the input is usually a pulse, with the hope that the output will be shaped something like (e) where there is a jump in sales followed by a gradual decline and an equilibrium at a higher level. Some studies have even found evidence of (f) where the net effect of the promotional activity has been negative.

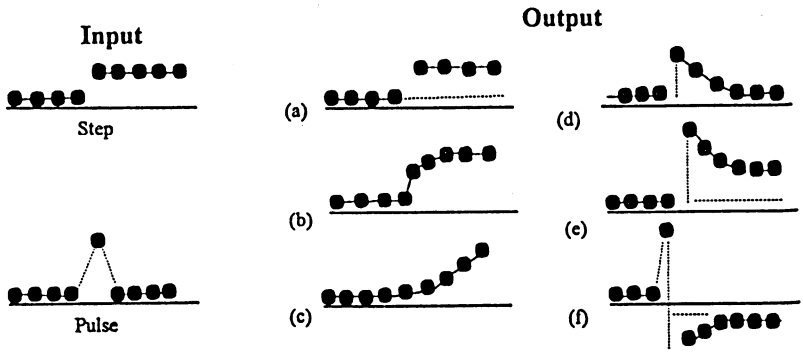

Figure 5 ***Transfer Function Responses***

The modeling efforts described below will measure the effects of the marketing intervention over the normal pattern of walnut shipments to Japan from 1976 to 1993. The period from 1976 to 1986 will be used to create a baseline model, which will then be used to forecast through the end of 1993 and measure the effects of the market development program. Table 2 provides summary statistics of the data that will be used. (The 24 observations from 1993:08 through 1995:07 have been withheld from the modeling procedure to provide an independent out-of-sample test of the model's validity.)

Table 2: Summary Statistics of Selected Series.

Series	PREADV	EVENT	COMBINED
Sample	1976:08-1986:07	1986:08-1993:07	1976:08-1993:07
Observations	120	84	204
Mean	39.67004	136.9561	98.09906
Median	28.55365	110.6799	65.46620
Maximum	228.0890	458.6048	502.2391

The Pre-Advertising Model

The Japanese market imported less than 1,000 tons of inshell equivalent walnuts until approximately 1986. We fit a model to the ten years (120 observations, from August 1976 to July 1986) prior to the market development activities by the walnut industry and identified it as the baseline model, what would have occurred in the absence of market development. Earlier data are available but a number of structural changes, very erratic imports by Japan, and new varietal developments would make a model with a longer sample period less valid.

A Box-Jenkins time series specification was used to model the period prior to the advertising activities, referred to as the PREADV model. Imports of walnuts are identified and estimated as a constant with an ARMA (p,q) error process; the model is then utilized to forecast a baseline from 1986 to 1993. Table 3 summarizes the model estimates.

Table 3: PREADV Model Estimates.

Variable	Coefficient	Std. Error	T-Statistic	Prob.
Constant	43.63432	6.013978	7.255483	0.0000
AR(1)	0.314131	0.087201	3.602380	0.0005
MA(12)	0.925910	0.012902	71.76266	0.0000

R-squared	0.574497	Mean dependent var	39.97481
Adjusted R-squared	0.567161	S.D. dependent var	37.80096
S.E. of regression	24.86945	Log likelihood	-549.760
Sum squared resid	71744.78	F-statistic	78.30926
Durbin-Watson stat	1.950327	Prob(F-statistic)	0.000000

Dependent Variable: Walnut shipments from the United States to Japan, measured in inshell tons.

The model accounts for most of the variation in the data, so that the autoregressive moving average does a good job in fitting the data, see Figure 6.

The Henriksson-Merton test[4] (a nonparametric test of direction) has a within-sample confidence level of 0.99, indicating that the model is successful in predicting changes in direction.

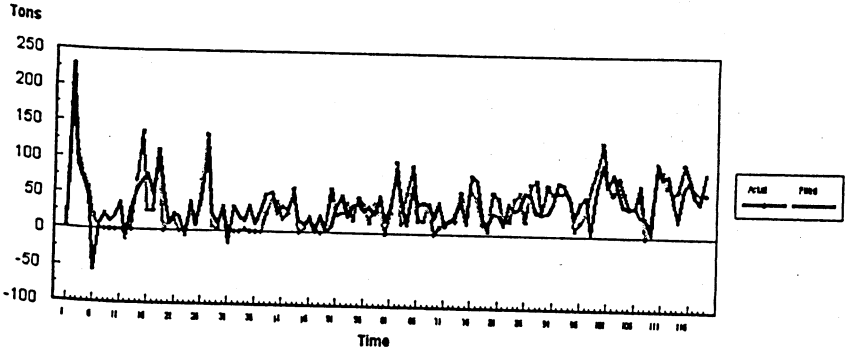

Figure 6 ***PREADV Model Results***

The Event Model

The PREADV model forecasts from August 1986 to July 1993 are used to calculate a base estimate of what would have occurred in the absence of the advertising campaign. A new variable, EVENT, is defined as the difference between the actual, observed shipments to Japan and the forecasted values from the PREADV model. This change in shipments will be modeled as a function of the change in advertising, using the intervention analysis methodology described above. The intervention model identifies and estimates the impacts of the total market development expenditures on the increased shipment levels over the baseline, *i.e.*, it specializes equation (4) by selecting particular forms of the polynomials in the backshift operator. Transfer function time series model identification procedures based on analysis of the cross autocorrelations and cross partials were utilized to determine the model structure. The erratic nature of the

[4]See Henriksson and Merton, 1981.

monthly advertising placements (see Figure 4) requires powerful modeling procedures to uncover the lag linkages to final shipments (see Figure 1); simply assuming a lag form as is typical in structural systems would not be successful in constructing an accurate model.

The transfer function relating advertising to shipments was identified as having a denominator polynomial of order 12, with a single lag at 12 (on the seasonal frequency), and a numerator polynomial of order 14 with coefficients at all lags, 0 through 14. These numerator weights of the rational distributed lag were adequately modeled by a third degree polynomial with a lag-length of 15 (including the current effect) with one tail restricted to be zero.

The error in the transfer function relation ε_t was identified as an ARMA(12, 12) with a single autoregressive coefficient [in $\kappa_2(B)$] at lag 12, and moving average coefficients at lags 1-6 and 12.

Table 4 gives the parameter estimates and summary statistics associated with this specification:

Table 4: EVENT Model Parameter Estimates.

Variable	Coefficient	Std. Error	T-Statistic	Prob.
$EVENT_{t-12}$	0.942309	0.107974	8.727176	0.0000
PDL01	0.014816	0.006880	2.153607	0.0365
PDL02	0.001820	0.003627	0.501815	0.6182
MA(1)	0.404939	0.061896	6.542213	0.0000
MA(2)	0.279041	0.056913	4.902923	0.0000
MA(3)	0.072478	0.080881	0.896107	0.3749
MA(4)	-0.140	0.069016	-1.980	0.0543
MA(5)	0.423459	0.078728	5.378790	0.0000
MA(6)	0.548118	0.088136	6.218989	0.0000
MA(12)	-0.740	0.071487	-10.410	0.0000
R-squared	0.731500		Mean depend. var	173.5326
Adjusted R-squared	0.667294		S.D. dependent var	104.5692
S.E. of regression	60.31624		Sum squared resid	167350.2
Log likelihood	-313.350		F-statistic	11.39294
D-W stat	2.003171		Prob (F-stat)	0.000000

The coefficient on the lagged dependent variable, $EVENT_{t-12}$, is significantly different from zero. All moving average terms in the transfer function

error model are significantly different from zero with the exception of the MA(3) term. The12th order autoregressive term has a negative sign that at first appears surprising; it is, however, consistent with the alternating nature of the impulse data observable in Figure 4, where advertising changes levels in alternate months.

The three terms denoted PDL01, PDL02, and PDL03 are the distributed lag polynomial terms. It is surprising that only one of these regressors is significant at any reasonable level.[5] With a tied tail, the third degree polynomial has two free parameters to track the 15 numerator weights; despite the insignificance, we were unwilling to have fewer free parameters for so many coefficients. As can be seen by solving for the implied weights (see Table 5 and Figure 7), the estimated weights have better *t* statistics than the PDL pseudo-variables and the lag pattern based on the third degree specification is highly plausible: the numerator lag weights decay, only to rise again at the seasonal frequency before a final decay, *i.e.*, the effects of promotion drop, then increase around a year later, and finally drop to the imposed zero (Figure 7).

[5]Note that the two nonsignificant PDL terms are related to the power of the polynomial (and thus the number of free parameters) and not to the lag length, *i.e.*, the two insignificant PDL terms do not imply that the lag length is too long, for example.

Table 5: Monthly Advertising Numerator Polynomial Weights for EVENT Model.

Lag	Weight	Std. Error	T-Statistic
t	0.03418	0.01697	2.01374
t-1	0.02481	0.01451	1.70941

Table 5: Monthly Advertising Numerator Polynomial Weights for EVENT Model.

Lag	Weight	Std. Error	T-Statistic
t	0.03418	0.01697	2.01374
t-2	0.01838	0.01339	1.37269
t-3	0.01445	0.01236	1.16891
t-4	0.01258	0.01093	1.15097
t-5	0.01231	0.00914	1.34669
t-6	0.01321	0.00750	1.76034
t-9	0.01840	0.00954	1.92852
t-10	0.01949	0.01126	1.73148
t-11	0.01951	0.01225	1.59266
t-12	0.01801	0.01203	1.49770
t-13	0.01456	0.01017	1.43162
t-14	0.00870	0.00629	1.38441
Sum of Lags	0.26011	0.08301	3.13359

This is just a partial analysis of advertising effects, however, and does not take into account the denominator polynomial in the backshift operator. We will

leave that analysis for discussion of the total model, combining both the pre-advertising noise model and the advertising event transfer function model.

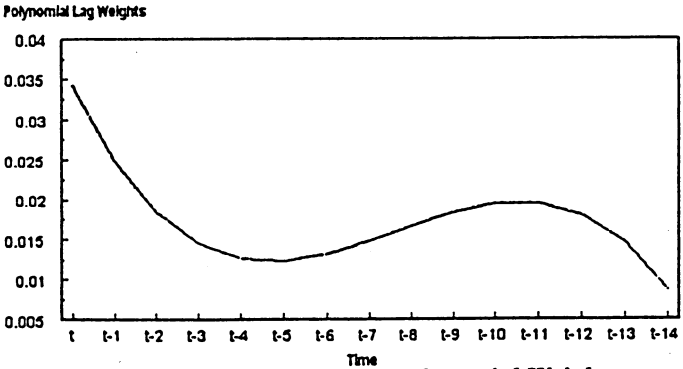

Figure 7 ***Monthly Advertising Numerator Polynomial Weights***

The Total Model

Adding the pre-advertising (noise) model to the event model [see equation (1)] results in a specific instance of the general equation (4), called the TOTAL model. This model can be used to predict shipments based on advertising, and to analyze the dynamic properties of the complete model and its components.[6]

Figure 8 presents the one period ahead forecasts of the combined model. Model performance is judged to be very good, particularly when taking into account the difficulty in connecting the highly variable advertising placements to the much smoother shipments to Japan.

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[6]Since the total model is the sum of the preadvertising and event models, the characteristic root and multiplier analysis could have been done for the separate components with the same results.

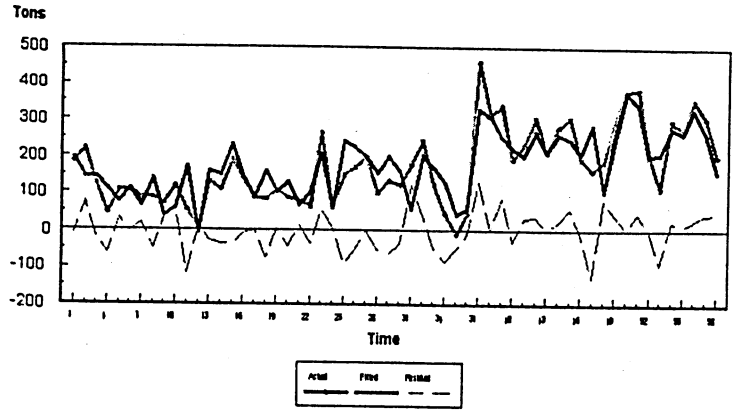

Figure 8 ***TOTAL Model Results***

The dynamic processes are all stable, *i.e.*, the roots of the denominator polynomials in the backshift operator in equation (4) are all outside the unit circle. Since the PREADV error dynamics are first order, the coefficient is the reciprocal of the polynomial root; thus the coefficient value of 0.31 (Table 3) obviously implies stability. Table 6 provides the roots of the EVENT model error dynamics and advertising transfer function terms, both 12th order polynomials in the backshift operator.

Table 6: Characteristic Roots of the Advertising Polynomials.

Transfer Function Error	Transfer Function Advertising
+ .527 + .913 i	+ .502 + .870 i
+ .913 + 527 i	+ .870 + .502 i
+ 1.054 + 0 i	+ 1.005 + 0 i
0 + 1.054 i	0 + 1.005 i

The unique pattern of the roots is a result of the single coefficient at the 12^{th} lag in both models. The absolute value of all 12 of the noise roots is 1.0543 (1/1.0543=0.9485 in the forward shift operator), well outside the unit disc and therefore stable and consistent with stationarity. The absolute value of the transfer function roots is 1.005, barely outside the unit anulus (1/1.005=0.9950 in the forward shift operator); advertising effects are very long-lived according to these estimates, which will surely make the Walnut Board happy. Indeed, the effects are nearly so persistent as to amount to a permanent change in consumption habits, although not quite.

Table 7 presents the first 36 advertising multipliers. Each multiplier is the estimated change in walnut shipments in the $t+1^{th}$ period ahead for a one unit change in advertising now, in this case tons of walnuts shipped for each $1,000 additional advertising expenditure.

Table 7: Advertising Multipliers for the TOTAL Model.

Lag	First Year, t=0	Second Year, t-12	Third Year, t=24
t	0.034	0.050	0.047
t+1	0.025	0.038	0.035
t+2	0.018	0.026	0.025
t+3	0.015	0.014	0.013
t+4	0.013	0.012	0.011
t+5	0.012	0.012	0.011
t+6	0.013	0.012	0.012
t+7	0.015	0.014	0.013
t+8	0.017	0.016	0.015
t+9	0.018	0.017	0.016
t+10	0.020	0.018	0.017
t+11	0.020	0.018	0.017

The seasonal nature of walnut advertising effects is evident in the large multiplier values on multiples of 12. A graph of the first 40 years of advertising multipliers makes the seasonality even more apparent; see the spikes on the seasonal frequency in Figure 9. Many of the activities are seasonal in nature, *i.e.* are only conducted during a specific time of the year, each year. This is particularly true for events like the new product development competition, special holiday television, radio, and magazine advertising, promotion of walnuts prior to the yearly national examinations, *etc.* The effect of trade and industrial consumption of walnuts in other commodities is apparent in the lag 12 multiplier being larger than the impact (lag 0) multiplier. While it may be possible to induce

direct consumers to buy now, the trade/industrial response is considerably more measured.

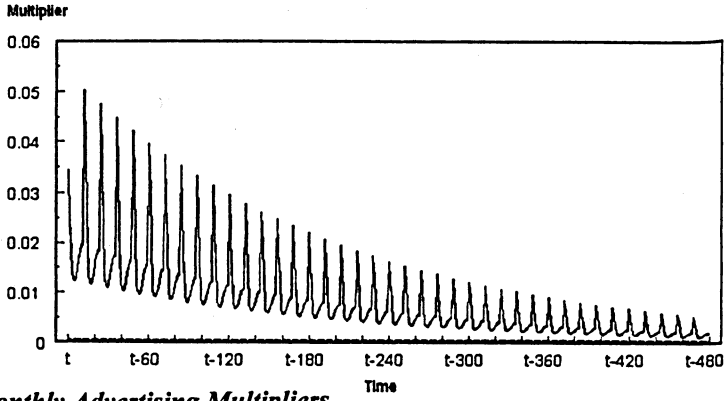

Figure 9 ***Monthly Advertising Multipliers***

In the limit,[7] the model estimates that 4.509 additional tons of inshell walnuts are ultimately shipped for every $1,000 dollars of advertising. It takes a very long time to attain the long run effects, however: at 40 years, 90.6 percent of the cumulative results of advertising have been achieved. The implied lag is consistent with the view of a long memory in the promotion activity, particularly for the industrial/trade sector. Producers are reluctant to change but once walnuts are introduced into recipes, they remain in them virtually indefinitely.

Conclusions

The time series modeling approach described above measures the impacts of market development activities in Japan since 1986, conducted by the U.S. walnut industry and funded by its members and the Market Promotion Program.

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[7] The effects stretch to infinity because of the denominator polynomial in the transfer function in equation 4.

High frequency data (monthly, rather than the more typical annual data) are used to determine the effect of specifically timed promotion activities on monthly shelled walnut shipments. Intervention analysis is employed to isolate the market development effects, and transfer function identification methods are utilized to determine the connections between the advertising placements and the resulting shipments.

We conclude that generally the program has been quite successful in the Japanese market. The analysis concludes that ultimately a cumulative increase in shelled walnut shipments of 4.5 tons results for every $1,000 of promotion expenditures. In other words, $1,000 spent in Japan, yields an increased revenue of approximately $5,850 (4.5 tons x 2,000 pounds per ton x $0.65 per pound, using a three year average farm price). This result is consistent with that obtained by Halliburton and Henneberry who found that "...the government received a return ranging from $4 to $9 for every dollar of Targeted Export Assistance and Market Promotion Program Expenditures spent in these three Pacific Rim countries."

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