A Method for Measuring Returns to Nonprice Export Promotion with Application to Almonds

Henry W. Kinnucan and Jason E. Christian

A formula is derived to indicate the marginal returns to nonprice promotion for a competitive industry that promotes in both the domestic and the export market and receives a subsidy for export promotion. Private returns to export promotion are an increasing function of the export promotion elasticity, the export share, and the promotion subsidy and a decreasing function of the domestic supply elasticity, the absolute values of the domestic and export demand elasticities, and opportunity cost. Applying the formula to almond promotion and using previously estimated elasticities, no firm conclusions can be made regarding the effectiveness of export promotion, chiefly because the estimated promotion elasticities are unstable. Assuming that the domestic promotion elasticity is robust, it appears that domestic market promotion is underfunded from a producer-welfare perspective unless the marginal rate of return on alternative uses of promotion funds is high, on the order of 115%.

Key words: almonds, export promotion, generic advertising, Market Promotion Program, Nerlove-Waugh theorem, opportunity cost

Introduction

In a recent issue of *Journal of Agricultural and Resource Economics,* Halliburton and Henneberry (HH) analyze the effectiveness of U.S. almond promotions in the Pacific Rim. Based on econometric estimates of promotion responses and a returns formula, HH find mixed results, but in at least one model the government return in three of five countries was positive. HH's analysis represents the first published evaluation of the U.S. Department of Agriculture's Market Promotion Program (MPP), a program that marks substantial increases in federal subsidies for nonprice export promotion since such subsidies were first introduced in 1954 as part of PL480 legislation (Spatz; Kinnucan and Ackerman).

The purpose of this research is to determine whether the rates of return computed by HH are sensitive to the shortcomings of their returns' formula. One of the formula's shortcomings, acknowledged by HH (p. 118), is "... it assumes that the cost of producing and exporting the additional unit of output is zero." A more fundamental shortcoming, however, is that the formula fails to take into account opportunity costs. Industry

dollars allocated to export promotion are dollars not available to domestic promotion or research, which may have higher relative payoffs (Wohlgenant). From the government perspective, the main focus of HH's analysis, taxpayer dollars allocated to almond promotion are dollars not invested in the promotion of protected commodities, promotion that could yield significant savings to taxpayers in the form of reduced outlays for price support (Ding and Kinnucan). Finally, HH's formula implicitly assumes that farm supply is fixed and demand is unitary elastic, assumptions that will cause returns to be understated if demand is price inelastic.

A description of the industry's structure and policy setting precedes developing the corrected formula. Applying the corrected formula to HH's results which are the most favorable toward export promotion, we find that the returns for the promotion-responsive countries are positive but larger than HH's estimates. Comparing the revised estimates to the marginal return from domestic market promotion, it appears that a different budget mix would have resulted in larger industry profits.

Structure and Policy Setting

Promotion effectiveness depends on an industry's trade status, competitive conditions, and policy setting (Alston, Carman, and Chalfant; Kinnucan and Hsia). The U.S. almond industry accounts for about two-thirds of world almond production and about four-fifths of world trade (Alston et al.). Thus, the industry is considered a "large country" exporter. That is, it has sufficient market presence to affect price through promotion. In addition, almond markets are highly integrated so that the law of one price holds across all markets (Alston et al.). A promotion-induced increase in the demand for almonds in an export market, therefore, can be expected to affect the domestic price.

The marketing channel for almonds in the domestic market is concentrated. About one-half of production is marketed through Blue Diamond Growers, Inc., a producer cooperative (Christian). However, Blue Diamond faces competition from low-cost independent handlers. In addition, about two-thirds of annual production is exported (Almond Board of California, Table III). Exported almonds face competition from foreign suppliers and local production. In Europe, a major market outlet, the dominant use is for marzipan and other confections; filberts (or hazelnuts) may be substituted to some extent in these markets. These factors, taken together, suggest that competitive forces are sufficient to assure price-taking behavior, a maintained hypothesis in this study.

The industry operates under a federal marketing order. Under the order, the Almond Board of California sets a reserve policy, conducts promotional and other marketing activities, funds research, enforces quality standards, and takes other actions that benefit the industry. Two board activities germane to this analysis are its reserve operations and promotion program. The promotion program was funded through a $0.008/lb.–$0.025/lb. mandatory assessment on almond marketings collected at the first-handler level. Initially the assessment was designed so that handlers could receive partial credit for approved promotional activities. Blue Diamond took advantage of this "credit back" feature to conduct extensive brand advertising. The credit-back provision, however, proved controversial and was eventually dropped. With the elimination of credit backs, program emphasis shifted from brand to generic promotions and to export promotion. Incentives to promote in the export market were enhanced by the inception of MPP in 1990, which

provided subsidies for *generic* promotion of up to nine dollars per industry dollar, compared with dollar-for-dollar matching for brand promotion (Kinnucan and Ackerman).

Reserve operations refer to board actions taken with respect to inventory. Under the order, the board is permitted to withhold a portion of a given crop from the market, either as an "unallocated reserve," which may later be released for sale, or as an "allocated reserve," which must be disposed of in certain approved outlets, such as the almond butter market, sale to oil presses, or use as animal feed. The export market, which was an approved outlet for allocated reserves in the 1970s, was seldom used for this purpose because of strong commercial sales (Bushnell and King) and has since lost that designation.

Because the allocated reserve in essence diverts quantity from fresh to secondary uses and thus does not constitute inventory per se, attention focuses on the unallocated reserve. In years of high unallocated reserve, the market could be supplied from inventory, which could have a dampening effect on any price increases associated with the industry's promotion programs. From a longer-run perspective, however, it appears that the main effect of the unallocated reserve has been to act as a buffer stock, smoothing price swings with little effect on average market prices over time (Alston et al.). This result, coupled with the finding that the law of one price holds so that there is nothing to be gained from "dumping" unallocated reserve onto foreign (or domestic) markets, suggests that reserve policy can be safely ignored when measuring industry returns to promotion.

Returns Formula

With the maintained hypothesis of competitive market clearing, our point of departure is Nerlove and Waugh's formula (p. 822) used to evaluate the Florida Citrus promotion program. That formula, which assumes that the industry sells into a single market, is as follows:

$$(1) \qquad\qquad MRR = [\beta/(\epsilon - \eta)](V^*/A) - 1,$$

where *MRR* is the marginal rate of return, β is the advertising or "promotion" elasticity, ϵ is the industry supply elasticity, η is the derived (farm-level) demand elasticity, V^* is the farm value of industry output in competitive equilibrium, and A is advertising expenditures. Equation (1) indicates the incremental effect of promotion on the "... aggregate of the profits of individual producers, net of both production costs and collective advertising expenditures" (Nerlove and Waugh, p. 820). In addition to competitive market clearing, the formula assumes: (*a*) absence of external economies or diseconomies, (*b*) an exogenous advertising expenditure, (*c*) absence of substitutes, and (*d*) that industry bears the full burden of the promotion "tax."

External economies or diseconomies are a concern when the industry in question is expanding or contracting rapidly over the evaluation interval or promotion causes large changes in industry output, which is not the case here. Total almond acreage over the past decade prior to 1994 has remained steady at about 425,000 (Almond Board of California, Table I) and promotion effects are modest. The exogenous-expenditure assumption may be questioned because funds for almond promotion are raised through a per-unit checkoff, which means that the total funds available for promotion vary with

the level of production. However, not all assessment dollars are spent for promotion and the checkoff itself represents less than 1% of total industry revenue.

The absence of substitutes is not a conceptual problem as long as the demand elasticity in (1) is interpreted as a general-equilibrium elasticity that reflects demand interrelationships at retail (Piggott, Piggott, and Wright) and input substitution at the middlemen level (Kinnucan 1997). For almonds, the only demand elasticities available are *partial equilibrium* elasticities measured at the farm level, and nothing is known about input substitution at the middlemen level. If the marketing technology for almonds is fixed proportions, a maintained hypothesis in this study, using a partial-equilibrium demand elasticity in (1) is innocuous for the purposes of this study because returns will be *understated.*[1] The returns are understated because partial-equilibrium demand elasticities in general are expected to be larger in absolute value than their general-equilibrium counterparts (Buse). With a larger demand elasticity, ceteris paribus, (1) produces a smaller return.

The per-unit checkoff is tantamount to an excise tax, which implies that industry does not bear the full burden of the checkoff unless farm supply is perfectly inelastic (Chang and Kinnucan). Nerlove and Waugh did not consider the "tax-shifting" phenomenon in their analysis. A formula that incorporates tax shifting and extends (1) to a multiple-market setting in which subsidy is available for export promotion is as follows (see appendix for derivation):

$$(2) \qquad MRR_i = \left[k_i \, \beta_i \, (1 \, + \, \tau)/\left(\epsilon \, - \, \sum_{j=1}^{n} k_i \, \eta_i \right) \right] (V^*/A_i) \, - \, \Omega,$$

where i indexes the market (domestic or foreign); k_i is ith market's quantity share, that is, $k_i = Q_i/Q_s$ where Q_s is domestic production and Q_i is the quantity sold in the ith market; τ is a parameter to indicate subsidy, that is, $\tau = A_i^G/A_i$ where A_i^G is government outlays for promotion in the ith export market and A_i is industry outlays for promotion *exclusive of subsidy*; and Ω is an incidence parameter that indicates industry's share of the checkoff.

Equation (2) differs from (1) in three ways. First, it disaggregates promotion and price responses across the n industry markets such that each response is weighted by a parameter k_i that indicates the importance of the promoted market in the overall demand for the commodity. Second, it contains a parameter τ to indicate the effect of a promotion subsidy targeted at a particular market on industry returns to promotion in that market. Finally, it contains a parameter Ω to reflect the hypothesis that in a competitive market, it does not matter whether an excise tax is imposed on the producer or the consumer; in general, both will share in the cost of the tax (Archibald and Lipsey).

The producer incidence of the promotion checkoff with a fixed-proportions marketing technology is defined as follows (Chang and Kinnucan, p. 170):

$$(3) \qquad \Omega = 1/\left(1 \, - \, \left(\epsilon/\sum_{i=1}^{n} k_i \, \eta_i \right) \right)$$

From (3) it is apparent that industry bears the full incidence ($\Omega = 1$) only if farm supply

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[1] A caveat to this statement is necessary when one industry's promotion program has a negative effect on the demand for another industry's product (e.g., almond promotion decreases the demand for walnuts). In this case, (1) *overstates* returns, unless almonds' market share is small relative to its substitutes (Kinnucan 1996).

is fixed ($\epsilon = 0$) or demand is perfectly elastic ($\eta_i \to -\infty$). Owing to the large-country trade status of the U.S. almond industry, the latter condition does not apply. Because newly planted almond trees require about three years to begin bearing commercial quantities (Alston et al.), one might argue that it is reasonable to treat farm supply as fixed, especially for "short-run" analysis. However, promotion-induced increases in price do eventually lead to increases in industry output, and it is useful to have a formula that permits returns to be measured over a longer time horizon.[2]

Equation (2) may be compared to HH's formula

$$(4) \qquad\qquad MRR_i^{HH} = (\beta_i\,k_i V^*)/(A_i \tau).$$

Comparing (2) and (4), it is evident that HH's measure implies that marginal returns are invariant to supply and demand elasticities, which is inconsistent with theory.[3]

Application

Equations (2) and (3) were used to reevaluate the returns to Pacific-Rim almond promotion using the baseline data and parameters indicated in table 1. The export promotion elasticities listed in table 1 are from HH's study, which includes estimates for three models: a Cobb-Douglas equation (Model A), a linear equation (Model B), and an exponential equation (Model C). Based on Model B's promotion elasticities, HH report (p. 118) marginal rates of return to the government of $4.95 for Japan, $5.94 for Taiwan, and $3.69 for Hong Kong. Based on these returns' estimates, the k_i for these countries were derived using equation (4) and the country-specific government outlays for promotion reported by HH as indicated in table 1. For the nonresponsive countries (South Korea and Singapore) values for k_i were computed using data supplied by the Almond Board of California.

HH did not estimate country-specific demand elasticities. The term $\sum_{i=1}^{n} k_i \eta_i$ in (2), therefore, was approximated using the expression $(k_d \eta_d + k_x \eta_x)$, where k_d and k_x are domestic and export market shares (0.33 and 0.67, respectively) and η_d and η_x, respectively, are domestic and export demand elasticities. Alston et al.'s (p. 59) estimate of the domestic demand elasticity for California almonds is -1.08, so η_d was set to -1.08. For export demand elasticities, Alston et al. (pp. 59 and 66) report estimates for 14 major export markets. The elasticity estimates for Germany and Japan, the two most important markets, are -0.700 and -0.431, respectively, which compare favorably with HH's de-

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[2] A reviewer questioned how equations (2) and (3) would have to be modified to reflect: (*a*) simultaneous promotions in other markets, (*b*) promotions for other products derived from the same commodity, and (*c*) promotions for different uses of almonds (e.g., retail versus institutional). Simultaneous promotions in other markets are reflected in (2) by the k_i parameter. In particular, simultaneous promotions in other markets imply less quantity sold in the *i*th market, which means a smaller market share, ceteris paribus. This, in turn, implies a smaller marginal return, as $\partial MRR_i/\partial k_i > 0$ in (2). Promotions of other products derived from the same commodity, such as marzipan and other confections in the case of almonds, could be reflected in (2) by replacing β_i with separate advertising elasticities for each product form. Returns to promoting retail versus institutional uses of almonds would be measured in the same way by estimating separate promotion elasticities for each end use or market.

[3] Following Williams (pp. 255–57), HH calculate a Foreign Agricultural Service or "government" return to promotion, where "returns" are defined to be the increased export revenue associated with the government share of the increased promotion expenditure. Although this measure may have its uses, we prefer to use producer surplus as the effectiveness measure. For one thing, it is not clear how increased export revenue per se yields benefits to government, unless export revenue is taxed or increased exports reduce government outlays for agricultural price subsidies (e.g., Ding and Kinnucan), situations that do not apply to almonds.

Table 1. Parameters and Baseline Data, U.S. Almond Industry, 1986–92

Parameter	Definition	Value
β_1	Domestic promotion elasticity[a]	0.1395
$\beta_2{}^A, \beta_3{}^A, \beta_4{}^A, \beta_5{}^A, \beta_6{}^A$	Export promotion elasticities: Model A[b]	0.0, 0.0, 0.0, 0.0, 0.0
$\beta_2{}^B, \beta_3{}^B, \beta_4{}^B, \beta_5{}^B, \beta_6{}^B$	Export promotion elasticities: Model B[b]	0.289, 0.0, 0.500, 0.400, 0.0
$\beta_2{}^C, \beta_3{}^C, \beta_4{}^C, \beta_5{}^C, \beta_6{}^C$	Export promotion elasticities: Model C[b]	0.0, 0.0, 0.851, 0.0, 0.0
η_x	Export demand elasticity[c]	−0.60, −0.80
η_d	Domestic demand elasticity[c]	−1.08
ϵ	Domestic supply elasticity	0.0, 0.30
$k_1, k_2, k_3, k_4, k_5, k_6$	Quantity shares × 100[d]	33.0, 7.23, 1.78, 0.87, 0.45, 0.58
S_2, S_3, S_4, S_5, S_6	Gov. promotion outlays ($ mil.)[e]	11.90, 4.11, 2.05, 1.37, 0.11
$A_1, A_2, A_3, A_4, A_5, A_6$	Industry promotion outlays ($ mil.)[f]	65.6, 9.08, 3.14, 1.56, 1.05, 0.08
τ	Gov. subsidy rate[g]	1.00, 1.31, 1.50
V^*	Farm revenue ($ mil.)[h]	2,809

Note: Subscripts denote countries as follows: 1 = United States, 2 = Japan, 3 = South Korea, 4 = Taiwan, 5 = Hong Kong, and 6 = Singapore.

[a] Source: Christian.

[b] HH's table 4. Models A, B, and C correspond to HH's equations (1), (2), and (3), respectively. Nonsignificant elasticities are set to zero.

[c] Sources: Alston et al.

[d] Derived from HH's data and tables III, VI, and VI.A of Almond Board of California.

[e] Source: HH's table 1.

[f] Figure for A_1 obtained from Christian and M. Marsh, Almond Board of California. Figures for A_2–A_6 were derived by dividing government outlays by 1.31, the average subsidy rate over the evaluation period.

[g] Low, average, and high values for 1986/87–92/93 fiscal years. Source: Peckins.

[h] Derived from HH's rate of return estimates.

mand elasticity estimate (linear model) of −0.61 for the Pacific Rim as a whole. According, η_x was set to −0.60, our "best guess" value. However, because Alston et al.'s reported demand estimates are not uniformly inelastic across importing countries and HH's Cobb-Douglas model indicated an elastic export demand (η_{PR} = −1.7), simulations were performed with η_x set to the more elastic value −0.80 to judge the sensitivity of results to this parameter.

The supply elasticity ϵ was set alternatively to zero and 0.30. Given the three-year biological lag in almond production and perhaps additional lags associated with price-expectation formation and institutional constraints (Alston et al.), simulations based on ϵ = 0 are interpreted as measuring the short-run effect of an increase in promotion, where the "short run" is defined as 3–4 years. (It is assumed that consumers respond fully to the promotion increase within this period.) Simulations based on ϵ = 0.3 are meant to reflect returns over a longer time horizon, say 5–8 years.

As emphasized by Nerlove and Waugh, if checkoff funds have alternative uses, evaluation of returns must take into account opportunity costs. In the case of export promotion, the obvious opportunity cost is the foregone earnings from not investing those same dollars in domestic market promotion. Returns to domestic market promotion can be determined from equations (2) and (3) by setting τ = 0 and inserting the baseline values and elasticities for the domestic market. Expenditures for domestic market promotion over the evaluation period (1985–92) totaled $65.6 million, which represents

Table 2. Marginal Returns to Almond Promotion in Pacific Rim and U.S. Markets for Alternative Values of the Supply Elasticity (ϵ), the Export Demand Elasticity (η_x), and Export Promotion Elasticities, 1986–92

| Market | $\epsilon = 0$ | | $\epsilon = 0.3$ | | HH Formula | |
	$\eta_x = -0.60$	$\eta_x = -0.80$	$\eta_x = -0.60$	$\eta_x = -0.80$	Industry	Gov.
Japan	−1.00[a]	−1.00	−0.72	−0.75	0.0	0.0
	18.8	15.8	13.4	11.8	6.48	4.95
	−1.00	−1.00	−0.72	−0.75	0.0	0.0
S. Korea	−1.00	−1.00	−0.72	−0.75	0.0	0.0
	−1.00	−1.00	−0.72	−0.75	0.0	0.0
	−1.00	−1.00	−0.72	−0.75	0.0	0.0
Taiwan	−1.00	−1.00	−0.72	−0.75	0.0	0.0
	22.7	19.1	16.3	14.3	7.78	5.94
	39.3	33.2	28.2	24.8	13.23	8.59
Hong Kong	−1.00	−1.00	−0.72	−0.75	0.0	0.0
	13.7	11.5	9.8	8.6	4.83	3.69
	−1.00	−1.00	−0.72	−0.75	0.0	0.0
Singapore	−1.00	−1.00	−0.72	−0.75	0.0	0.0
	−1.00	−1.00	−0.72	−0.75	0.0	0.0
	−1.00	−1.00	−0.72	−0.75	0.0	0.0
U.S.	1.60	1.21	1.14	0.90	1.97	—

Note: Assumes that government provides $1.31 per industry dollar for export promotion, that is, $\tau = 1.31$.

[a] Top, middle, and bottom numbers correspond to the export population elasticities from Models A, B, and C, respectively, from HH's analysis (see table 1).

$10.0 million in generic advertising by the Almond Board and $55.6 million of brand advertising by Blue Diamond.

The domestic promotion elasticity, which was estimated utilizing Blue Diamond advertising data for the period 1970–92 (Christian), is 0.1394. This estimate is smaller than the Pacific-Rim promotion elasticities estimated by HH, which range from 0.289 for Japan in the linear model to 0.851 for Taiwan for the exponential model. However, it is consistent with the brand elasticities for nondurables reported by Sethuramam and Ellis, which average 0.09 for short-run estimates. Christian's elasticity was estimated with annual data without a lag structure, so it may be interpreted as a long-run elasticity.

Results

Comparison with HH's Estimates

Our results based on equations (2) and (3) show positive returns in all markets exhibiting a positive promotion response according to HH's Models B and C (table 2). Thus, HH's basic conclusion that promotion in Japan, Taiwan, and Hong Kong is profitable *when these model estimates are used* is confirmed by our analysis. However, the marginal returns implied by HH's formula for the promotion-responsive countries are much smaller

than the returns produced by our formulas. Thus, it appears that HH's formula seriously understates industry returns to export promotion when promotion elasticities are positive.[4]

A comparison of the returns' estimates for the nonresponsive countries (South Korea and Singapore in Model B, all countries in Model A, and all countries except Taiwan in Model C) highlights the importance of taking into account incremental costs and the tax-shifting hypothesis. HH's formula implies that the incremental returns for the nonresponsive countries are zero, when in fact they are negative. In particular, if supply is fixed, industry bears the full cost of the incremental promotion outlay, and the loss from investing in a nonresponsive market is dollar for dollar. However, if supply is upward sloping, some of the cost is shifted to consumers, which reduces the losses sustained by producers when promotion is ineffectual. The degree of cost shifting in the case of almonds appears to be about 26.5%, as the marginal losses for the nonresponsive countries decline from -1.00 to between -0.72 and -0.75 as supply tilts away from the vertical (table 2).

Market Allocations

For a given budget, investment levels are optimized when marginal returns are equated across markets, including the domestic market. Marginal returns for domestic market promotion range from 0.90 when export demand is relatively elastic ($\eta_x = -0.80$) and supply is responsive to price ($\epsilon = 0.3$) to 1.60 when export demand is relatively inelastic ($\eta_x = -0.60$) and supply is fixed ($\epsilon = 0$). Because these returns' estimates are uniformly less than the corresponding estimates for the responsive Pacific Rim countries obtained from HH's Models B and C, it appears that a different budget allocation would have resulted in higher industry profits. For example, *if Model B's results are accepted,* it appears that, with the benefit of hindsight, industry profits could have been increased by spending relatively more in Taiwan, Japan, and Hong Kong, relatively less in the domestic market, and nothing at all in South Korea and Singapore.

The returns reported in table 2 are based on $\tau = 1.31$, the average subsidy rate over the 1986–92 evaluation period. Because the subsidy rate over this period varied from 1.00 (dollar-for-dollar matching) to 1.50, and recent reductions in MPP funding imply less generous subsidies in the future, it is of some interest to know how the allocations would be affected by changes in the subsidy. For this purpose, we used the promotion elasticities from HH's Model B and "simulated" equations (2) and (3) for alternative values of τ as indicated in table 3. The simulations assume that the supply elasticity is 0.3 and the export demand elasticity is -0.6.

Although marginal returns are sensitive to subsidy, the conclusion from Model B that industry was underinvesting in Taiwan, Japan, and Hong Kong relative to the domestic market is not altered for the range of subsidies observed over the evaluation period (table 3). The subsidy, moreover, appears to be only slightly distortionary in the sense that even at the lowest subsidy rate ($\tau = 1.00$) the efficient solution (based on Model B's promotion elasticities) still involves diverting funds from domestic market promotion to the responsive Pacific-Rim markets.

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[4] The returns reported in table 2 from our formulas are to be interpreted as *industry* or private returns. Government returns are not computed for the previously stated reasons (see footnote 3).

Table 3. Sensitivity of Returns to Subsidy Based on HH's Model B Promotion Elasticities

Market	Private MRR Export Subsidy Rate (τ)[a]		
	$\tau = 1.00$	$\tau = 1.31$[b]	$\tau = 1.50$
Japan	8.6	13.4	16.8
Taiwan	10.5	16.3	20.3
Hong Kong	6.3	9.8	12.4
United States	1.14	1.14	1.14

[a] Assumes that $\epsilon = 0.3$ and $\eta_x = -0.6$.
[b] The average subsidy rate for the period 1986–92. The 1.00 and 1.50 reflect the low and high values over the sample period (Peckins).

Optimal Expenditures

The optimal industry expenditure in each market, assuming that sufficient funds are available, occurs where the marginal rate of return in each market is equal to the opportunity cost of the total promotion program. Letting ρ be this opportunity cost (e.g., the marginal return on industry-sponsored research), the optimal expenditure for promotion in the ith market can be determined by setting (2) equal to ρ and solving for A_i, which yields

$$(5) \qquad A_i^* = k_i \beta_i V^* (1 + \tau) / \left[\left(\epsilon - \sum_{i=1}^{n} k_i \eta_i \right) (\rho + \Omega) \right],$$

where A_i^* is interpreted as the promotion expenditure in the ith market that maximizes producer surplus (quasi-rent) for a given crop value V^*. From (5), the optimal expenditure level in the ith market increases as: (*a*) the market becomes more responsive to promotion, (*b*) the subsidy becomes more generous, (*c*) supply or demand becomes less elastic, (*d*) industry incidence of the checkoff decreases, and (*e*) the opportunity cost of the promotion investment decreases.

Optimal expenditures for the responsive Pacific-Rim markets (Model B's results) and the domestic market for alternative values of the opportunity-cost parameter are indicated in table 4. The simulations assume that supply is upward sloping ($\epsilon = 0.3$) and that η_x equals -0.6, our "best guess" export-demand elasticity. The subsidy parameter (τ) is set to the average rate over the evaluation interval. The opportunity-cost parameter (ρ) is set alternatively to 0.20, 0.40, and 0.60, which implies that alternative uses of promotion funds could earn a marginal rate of return of between 20% and 60%. This range appears to reflect what a crop industry in the United States could expect from private investment in agricultural production research (Huffman and Evenson).[5]

The optimal expenditures, although sensitive to opportunity costs, always exceed actual expenditures for the range of parameter values indicated in table 4. The optimal/actual expenditure ratios across markets range from 1.41:1 for the domestic market to

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[5] The implicit assumption here is that production research represents the next-best use of checkoff funds, as suggested by Wohlgenant's analysis. To the extent that the selected values for ρ *overstate* the marginal returns to production research, the analysis will be prejudiced in favor of research and against promotion.

Table 4. Optimal Promotion Expenditures Based on HH's Model B's Promotion Elasticities and Alternative Values of the Opportunity Cost Parameter (ρ), U.S. Almond Industry, 1986–92

Market	Actual Expenditure ($ mil.)[a]	Ratio of Optimal to Actual Expenditure[b]		
		$\rho = 0.20$	$\rho = 0.40$	$\rho = 0.60$
Japan	9.1	15.4	12.6	10.7
Taiwan	1.6	18.1	14.9	12.6
Hong Kong	1.1	10.9	9.0	7.6
U.S.	65.6	2.03	1.57	1.41

Note: If Model A's elasticities are used, the optimal strategy is not to promote at all in the Pacific Rim. If Model C's elasticities are used, the optimal strategy is to promote only in Taiwan and the United States.

[a] Industry expenditures exclusive of subsidy.

[b] Assumes $\epsilon = 0.3$, $\eta_x = -0.60$, and $\tau = 1.31$.

12.6:1 for Taiwan when opportunity costs are relatively high ($\rho = 0.60$) to between 2.03:1 and 18.4:1 when opportunity costs are relatively low ($\rho = 0.20$) *and Model B's promotion elasticities are deemed applicable.* If Model B's promotion elasticities are not applicable, the optimal strategy is to promote only in the domestic market (Model A) or the domestic market plus Taiwan (Model C). In either case, it appears that industry expenditures on promotion were suboptimal in the sense that higher rents could have been achieved, *net of foregone returns to research,* if more funds had been allocated to domestic market promotion.

Concluding Remarks

The basic theme of this article is that opportunity costs are an essential element of promotion evaluation. The analysis builds on Nerlove and Waugh's theory of cooperative advertising by extending their model to a multiple-market setting in which a subsidy is provided for export promotion and the cost of the promotion is shared with consumers through tax shifting. Applying the returns' formulas based on this theory to almond promotion in the Pacific Rim and using previously estimated elasticities, we find that owing to the instability of the estimated promotion elasticities, no firm conclusions can be made about the effectiveness of export promotion.

For domestic market promotion, which accounts for the bulk of the expenditures, results suggest that the program is underfunded unless the marginal rate of return on alternative uses of checkoff funds is high, on the order of 115%.[6] Because private marginal rates of return to crop research are generally not expected to be above 60%, almond

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[6] The basis for this statement is the minimum value of ρ required to force the smallest ratio in table 4 below one, which is $\rho = 1.15$.

producers and handlers should not be indifferent about the allocation of checkoff funds to promotion and research.

A caveat in interpreting our results is that the results implicitly assume that the estimated elasticities that underlie the returns' estimates are reliable. Given the sensitivity of HH's estimates to functional form and the fact that Christian's estimates pertain to only one functional form, more econometric work is needed to confirm previous estimates and to update the parameters. Then, too, the optimal spending levels identified in this article for domestic market promotion implicitly assume that the domestic promotion elasticity, even if reliable, does not change with the level of expenditure, which is unlikely given the size of the underfunding indicated by the formulae. Prudence dictates that any changes in promotion strategy be accompanied by econometric work to determine the extent to which the elasticities themselves are affected by the new policy.

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References

Almond Board of California. "California Almonds Statistical Tables." Modesto CA, September 1994.

Alston, J., H. Carman, and J. Chalfant. "Evaluating Primary Product Promotion: The Returns to Generic Advertising by a Producer Cooperative in a Small, Open Economy." In *Promotion in the Marketing Mix: What Works, Where and Why?*, eds., E. W. Goddard and D. S. Taylor, Dept. Agr. Econ., University of Guelph, 1994.

Alston, J., H. Carman, J. Christian, J. Dorfman, J. Murua, and R. Sexton. *Optimal Reserve and Export Policies for the California Almond Industry: Theory, Econometrics and Simulations.* Monograph No. 42. Giannini Foundation of Agricultural Economics, California Agr. Exp. Sta., Davis CA, February 1995.

Archibald, G. C., and R. G. Lipsey. *A Mathematical Treatment of Economics,* 1st Indian ed. New Dehli: Virender Kumar Arya, 1984.

Buse, R. R. "Total Elasticities—A Predictive Device." *J. Farm Econ.* 40(1958):881–91.

Bushnell, P. G., and G. King. "The Domestic and Export Markets for California Almonds." Res. Rep. 334, Giannini Foundation of Agricultural Economics, Div. Agr. and Nat. Resour., University of California, Oakland, 1986.

Chang, H.-S., and H. W. Kinnucan. "Economic Effects of an Advertising Excise Tax." *Agribusiness* 7(1991): 165–71.

Christian, J. "The Economic Effects of Advertising in the California Almond Industry." Unpub. ms., Dept. of Agr. Econ., University of California, Davis, September 1994.

Ding, L., and H. W. Kinnucan. "Market Allocation Rules for Nonprice Promotion with Farm Programs: U. S. Cotton." *J. Agr. and Resour. Econ.* 21(1996):351–67.

Halliburton, K., and S. R. Henneberry. "The Effectiveness of U.S. Nonprice Promotion for Almonds in the Pacific Rim." *J. Agr. and Resour. Econ.* 20(1995):108–21.

Huffman, W. E., and R. E. Evenson. "Contributions of Public and Private Science and Technology to U.S. Agricultural Productivity." *Amer. J. Agr. Econ.* 74(1992):751–56.

Kinnucan, H. W. "A Note on Measuring Returns to Generic Advertising in Interrelated Markets." *J. Agr. Econ.* 47(1996):261–67.

———. "Middlemen Behaviour and Generic Advertising Rents in a Competitive Food Industry." *Aust. J. Agr. and Resour. Econ.* 41(1997):forthcoming.

Kinnucan, H. W., and K. Z. Ackerman. "Public Funding of Foreign Market Development Programs." In *Public Policy in Foreign and Domestic Market Development,* ed., D. I. Padberg, pp. 121–34. Dept. of Agr. Econ., Texas A&M University, 1995.

Kinnucan, H. W., and C.-J. Hsia. "Determinants of Generic Advertising Effectiveness." *Agr. Mktg. Rev.* 2(1997):forthcoming.

Nerlove, M., and F. Waugh. "Advertising without Supply Control: Some Implications of a Study of the Advertising of Oranges." *J. Farm Econ.* 43(1961):813–37.

Peckins, S. Agricultural Marketing Specialist. Foreign Agricultural Service. U. S. Department Agriculture. Personal communication, 6 November 1995 and 4 November 1996.

Piggott, R. R., N. E. Piggott, and V. E. Wright. "Approximating Farm-Level Returns to Incremental Advertising Expenditure: Methods and Application to the Australian Meat Industry." *Amer. J. Agr. Econ.* 77(1995):497–511.

Sethuraman, R., and G. J. Ellis. "An Analysis of the Tradeoff between Advertising and Price Discounting." *J. Mktg. Res.* 28(1991):106–74.

Spatz, K. J. "Export Market Development by Agricultural Commodity Promotion Programs." Res. Rep. No. 79, U. S. Department Agriculture, Agricultural Cooperative Service, April 1989.

Williams, G. W. "Returns to U. S. Soybean Export Market Development." *Agribusiness* 1(1985):243–63.

Wohlgenant, M. K. "Distribution of Gains from Research and Promotion in Multi-Stage Production Systems: The Case of the U. S. Beef and Pork Industries." *Amer. J. Agr. Econ.* 75(1993):642–51.

Appendix: Derivation of Returns Formula

To begin, assume that the industry sells its product in the domestic market ($i = 1$) and $n - 1$ export markets. Assume further that the world market is integrated so that the law of one price holds. Holding constant all exogenous variables that affect supply and demand except promotion, the structural model may be specified as follows:

(A1)   Domestic demand: $Q_1 = D^1(P, A_1)$,

(A2)   Export demand: $Q_i = D^i(P, A_i(1 + \tau))$ for $i = 2, 3, \ldots, n$,

(A3)   Domestic supply: $Q_s = S(P)$,   and

(A4)   Market equilibrium: $Q_s = \sum_{i=1}^{n} Q_i$,

where Q_i is the quantity of the U. S. agricultural product sold in the ith market; P is the price received by domestic producers; A_i is industry outlays for promotion in the ith market, which may be zero in some markets; τ is the subsidy parameter, that is, $\tau = A_i^G/A_i$ where A_i^G is the government outlay for promotion in the ith export market; and Q_s is domestic production.

The first task is to develop a reduced-form expression that indicates the effect of an increase in promotion in the ith market on equilibrium price. For this purpose, first express (A1)–(A4) in logarithmic-differential form as follows:

(A1′) $d \ln Q_1 = \eta_1 \, d \ln P + \beta_1 \, d \ln A_1$,

(A2′) $d \ln Q_i = \eta_1 \, d \ln P + \beta_i(1 + \tau) \, d \ln A_i$ for $i = 2, 3, \ldots, n$,

(A3′) $d \ln Q_s = \epsilon \, d \ln P$,   and

(A4′) $d \ln Q_s = \sum_{i=1}^{n} k_i \, d \ln Q_i$,

where $d \ln Z = d Z/Z$ is the relative change in variable Z and the coefficients of the $d \ln Z$ terms are as defined in the text. Setting $d \ln A_i = 0$ for $i = 2, 3, \ldots, n$, substituting (A1′)–(A3′) into (A4′), and solving for $d \ln P$ yields

(A5) $$d \ln P = \left[k_1 \beta_1 \Big/ \left(\epsilon - \sum_{i=1}^{n} k_i \eta_i \right) \right] d \ln A_1.$$

Equation (A5) indicates the effect of an isolated increase in promotion in the *domestic* market on equilibrium price taking into account supply response and equilibriating adjustments across markets in response to the promotion-induced diversion of quantity from export markets. The corresponding price effect of an isolated increase in promotion in the *i*th *export* market is obtained in a similar fashion by setting $d \ln A_1 = 0$, which yields

(A6) $d \ln P = \left[k_i \beta_i (1 + \tau) \middle/ \left(\epsilon - \sum_{i=1}^{n} k_i \eta_i \right) \right] d \ln A_i$ for $i = 2, 3, \ldots, n$.

The next task is to develop an expression that indicates the effect of an increase in promotion in the *i*th market on industry profit. For this purpose, let the industry profit function be defined as follows:

(A7) $R = P^*(Q_1^* + Q_2^* + \ldots + Q_n^*) - \int_0^{Q^*} S^{-1}(t) \, dt - \Omega(A_1 + A_2 + \ldots + A_n),$

where R is producer surplus (quasi-rent) net of industry outlays for promotion; P^* is equilibrium price; Q^* ($= Q_s$) is total equilibrium quantity; Q_i^* is equilibrium quantity in the *i*th market ($Q_1^* + Q_2^* + \ldots + Q_n^* = Q^*$); $S^{-1}(Q_s)$ is the industry supply function written in inverse form, that is, price as a function of quantity in (A3); and Ω is the producer incidence of the promotion levy. Equation (A7) is identical to Nerlove and Waugh's profit function (p. 821) except that the market is disaggregated and tax shifting is taken into account through the incidence parameter Ω.

Marginal returns to promotion in the domestic and the *i*th export market are obtained by differentiating (A7) with respect to A_1 and A_i, respectively, which yields

$$MRR_1 = Q^* \, \partial P^* / \partial A_1 - \Omega, \quad \text{and}$$

$$MRR_i = Q^* \, \partial P^* / \partial A_i - \Omega \qquad i = 2, 3, \ldots, n.$$

Converting the derivatives in these expressions to elasticities yields

$$MRR_1 = (P^* Q^* / A_1) \, d \ln P^* / d \ln A_1 - \Omega, \quad \text{and}$$

$$MRR_i = (P^* Q^* / A_i) \, d \ln P^* / d \ln A_i - \Omega \qquad i = 2, 3, \ldots, n,$$

which, upon substituting (A5) and (A6), give the desired returns' formulas:

(A8a) $MRR_1 = \left[k_1 \beta_1 \middle/ \left(\epsilon - \sum_{i=1}^{n} k_i \eta_i \right) \right] (V^* / A_1) - \Omega, \quad \text{and}$

(A8b) $MRR_i = \left[k_i \beta_i (1 + \tau) \middle/ \left(\epsilon - \sum_{i=1}^{n} k_i \eta_i \right) \right] (V^* / A_i) - \Omega \qquad i = 2, 3, \ldots, n.$

Comparing these expressions, it is apparent that the returns' formula for the export market (A8b) reduces to the returns' formula for the domestic market (A8a) when the subsidy vanishes, that is, $\tau = 0$. Thus, equation (A8b) is a general expression for the marginal returns to promotion in *any* market, domestic or foreign, for a competitive industry that wishes to maximize producer surplus. *QED*