Real Christmas Tree Board Evaluation Report

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September 1, 2025

Real Christmas tree demand varied considerably over the past five years (2020 - 2024), but it is not clear from casual inspection whether this variability is due to pricing, the competitive effect from fake Christmas trees, or other market factors. In general, the economic climate in the U.S. following the COVID-19 pandemic was one of general uncertainty, a renewal of price inflation, and yet solid economic growth. All of these factors may influence the demand for real Christmas trees. Moreover, relative to the previous evaluation period (2017 - 2019), the Real Christmas Tree Board (RCTB) has fundamentally altered their approach to marketing, moving away from homegrown video to rely more on public relations and social media, and their interaction. In this report, we separate the effect of general economic trends from marketing activities by the RCTB in providing an estimate of the returns to marketing promotions by the RCTB over a 2020 - 2024 evaluation period. In the paragraphs that follow, we summarize our findings from an econometric analysis of RCTB marketing activities.

Executive Summary

- Project Objectives: The primary objective of this evaluation is to estimate the long-run impact of Real Christmas Tree Board (RCTB) promotion activities, defining promotion to include all public relations, video, social media and other activities over the 2020-2024 seasons, on the demand for U.S. Christmas trees, and to use these impact estimates to calculate the return on investment (ROI) for all stakeholders.[1]

- Study Design: We use econometric methods to disentangle the effect of RCTB promotion programs on retail Christmas tree sales from the many other factors that may cause demand to change over time, and to vary between Christmas tree consumers. Our primary data source is the National Christmas Tree Association (NCTA) survey. We use RCTB records to measure the intensity of each promotion activity over the previous 8 year period.[2] Using

[1] Our focus on public-relations, video, and social media investments reflects a desire to remain consistent with our previous analysis in 2020, although the data show substantial shifts in strategy among these two activities, namely away from video and toward public relations and social media, over the more recent period.

[2] We include the previous 2017 - 2019 period with the newer data to aid in econometric identification, but our invest-

this data, we estimated a series of econometric models intended to quantify the relationship between RCTB activities and consumer demand. The econometric models provided response elasticities that were used as input to a dynamic return on investment (ROI) simulation model for each activity.

- Data Quality: As in our previous analysis, we understand that there remain important concerns within the industry regarding the validity of the NCTA consumer survey. These concerns are based on the fact that the implied number of real Christmas trees sold on an annual basis is unrealistic, perhaps because of sampling bias in the Harris survey. Regardless, the raw data from the survey provides a reliable guide to the factors that cause consumers to purchase trees: Prices, point-of-sale, fake-tree prices, income and other factors that we know to be important drivers of the real Christmas tree purchase decision. As we show below, the statistical model we applied to the NCTA survey data provide an excellent fit to the raw survey data, particularly when we add the 2020 - 2024 data to the previous 2017 - 2019 data.

- Econometric Estimates: Our findings consist of empirical estimates of the price-elasticity of demand (sensitivity of Christmas tree consumers to changes in price), a composite advertising-elasticity of demand, and a return-on-investment (ROI) estimate for RCTB promotion activities, both in the short and long-runs. We found a short-run price elasticity of demand for Christmas trees of -0.254, and a long-run price elasticity of -0.692, which implies relatively inelastic demand for Christmas trees. Controlling for prices and a number of socio-economic variables, we found a short-run promotion elasticity with respect to an aggregate of all promotion activities of 0.052 and a long-run elasticity of 0.143. The short-run estimate implies that a 10 % increase in promotion activity will result in a 0.52 % increase in the probability a consumer purchases a real Christmas tree. Relative to other commodities, these estimates indicate a comparatively strong impact of promotion activities on demand.

- Return-on-Investment: We then use these econometric estimates to calculate the implied rate of return to RCTB promotion activities. We find that the short return benefit:cost ratio (BCR) to total RCTB advertising impressions is 6.976 and the long-run BCR is 13.116, which are both substantially lower than their values in our 2020 evaluation, but still indicate that RCTB programming remains highly profitable. These estimates suggest that one more dollar invested in promotion activities can be expected to generate an additional $6.98 in grower profit in the short run, and $13.12 in the long run. Both suggest that grower investments in the RCTB are highly profitable as the short-run ROI is 598.1% in the short run and over 1,212% in the long run. Both values are clearly well above growers' opportunity cost of capital.

- Data Recommendation: We find that the NCTA survey is a valuable source of demand data, but the RCTB would be well served to devise a method of gathering either retail-sales or grower-shipment data. One option would be to gather data from card-processing firms at point-of-sale in private lots and you-cut farms, for instance. Data like this would both facilitate future analyses like this one, and allow RCTB management to conduct annual ROI-studies of the returns to promotion programs in a more timely and granular way. The NCTA survey itself could also be improved by adding questions regarding whether or not respondents were aware of RCTB advertising campaigns, and perhaps test image recall and awareness.

Introduction

According to the Census of Agriculture (USDA-NASS 2022), the number of Christmas trees harvested between 2017 and 2022 fell from 15.1 million to 14.55 million trees. However, over the same period the number of farms reporting sales of real Christmas trees rose slightly from 15,008 to 16,612. Over the same period, the total acreage in trees fell by about 1% from 295,162 acres to 292,050 acres. Based on NCTA survey data, the price of real Christmas trees has stayed roughly constant at an average of between $110.00 and $120.00 per tree, while the total number of trees implied by the survey has increased by some 60%, from roughly 18.0 million in 2020 to over 30.0 million in 2024 (figure 1). While the macroeconomy has been relatively strong over the 2020 - 2024 sample period, the NCTA survey data shows a picture of the real Christmas tree industry that is somewhat

ment values include only the 2020 - 2024 period under study.

different from the Census of Agriculture. Regardless, both data sources show that the demand for real Christmas trees is at least constant in the face of growing demand for fake Christmas trees, which are largely imported from relatively inexpensive off-shore sources (figure 2).[3] Promoting real Christmas trees is, therefore, essential and the role of the RCTB in driving demand in this complex and dynamic market is a question that needs to be resolved through fact-based data analysis.

As required by the Federal Agriculture Improvement and Reform Act of 1996, all federally sanctioned research and promotion programs must conduct an econometric assessment of the impact of their activities on stakeholder profitability. In order to ensure that this analysis represents more than due diligence under the Act, we conducted both an econometric analysis and ROI calculation exercise that be useful in helping RCTB managers make more efficient use of stakeholder check-off funds. Specifically, for this analysis, we estimate the marginal effect of impressions on demand from video, social media, and public relations investments. In order to make the most efficient use of a limited marketing budget, the total impact is optimized when the marginal effect from each budget-alternative is equalized. In the narrative below, we interpret our findings from models that focus on each activity on its own relative to this benchmark. Our insights in this regard are particularly important given the volatile nature of the Christmas tree market, competition from fake Christmas trees, and changes in the demographic profile of real Christmas tree buyers.

Objectives

The primary objective of this research is to estimate the long-run effectiveness of RCTB promotion and research activities over the 2020 - 2024 period.[4] Our analysis, however, only reports returns for the previous five years. Throughout this analysis, we define effectiveness in terms of the return on stakeholders' investment in marketing activities intended to increase demand in the consumer market. Our research also generated a number of other outputs of interest to RCTB stakeholders, including estimates of:

- The long-run impact of RCTB marketing activities on the market demand for Christmas trees, aggregating over tree-types, states, and channels of distribution, using a variety of econometric modeling techniques applied to the available survey data. Although the RCTB undertakes a wide range of outreach activities, we focus on broad classes for which the data are available: Video, social media, and public relations. Over the previous five-year period, the RCTB has moved substantially away from creating and posting their own videos, to relying more on public relations and social media activities, and relying on the organic spread of both across consumers. In each case, we use econometric methods to control for potentially-confounding factor such as real Christmas tree prices, fake Christmas tree prices, changes in distribution channels, and socio-economic attributes of our survey respondents;

- The long-run impact of RCTB marketing activities on prices paid to growers by Christmas tree retailers, wholesalers, or directly by consumers through an econometric simulation model of the real Christmas tree supply chain;

- The expected annual increment to grower profit, the net present value of all future profit (net of program costs) and, ultimately, the ROI due specifically to RCTB marketing activities;

Data Sources

To achieve these objectives, we used the best data possible. Our primary demand data consists of eight prior NCTA surveys. For this analysis, we use data from these surveys in raw form, which provides indicators of what type of tree each respondent displayed each year, whether a real tree was purchased, where it was purchased, and the price paid. The survey data also includes a wide variety of demographic and socio-economic measures for each household, including age, education, income, household size, whether the residence is owned or rented, and whether the household's location is in an urban or rural area.

Data for the level or intensity of investment in each marketing activity by the RCTB are from RCTB records. These data are, in turn, largely derived from third-party marketing firm records. The internal

[3] Note for the purposes of this report that the number of real trees cut is equal to the number purchased. We have no data on trees that were cut, but not purchased.

[4] Note that our data covers a longer period than this, because the NCTA survey provides a consistent data set of nationally-representative real Christmas tree purchases over a longer 2017 - 2024 period. We only interpret our findings relative to the previous five years of program investment.

Figure 1. Trees Cut and Price, by Year

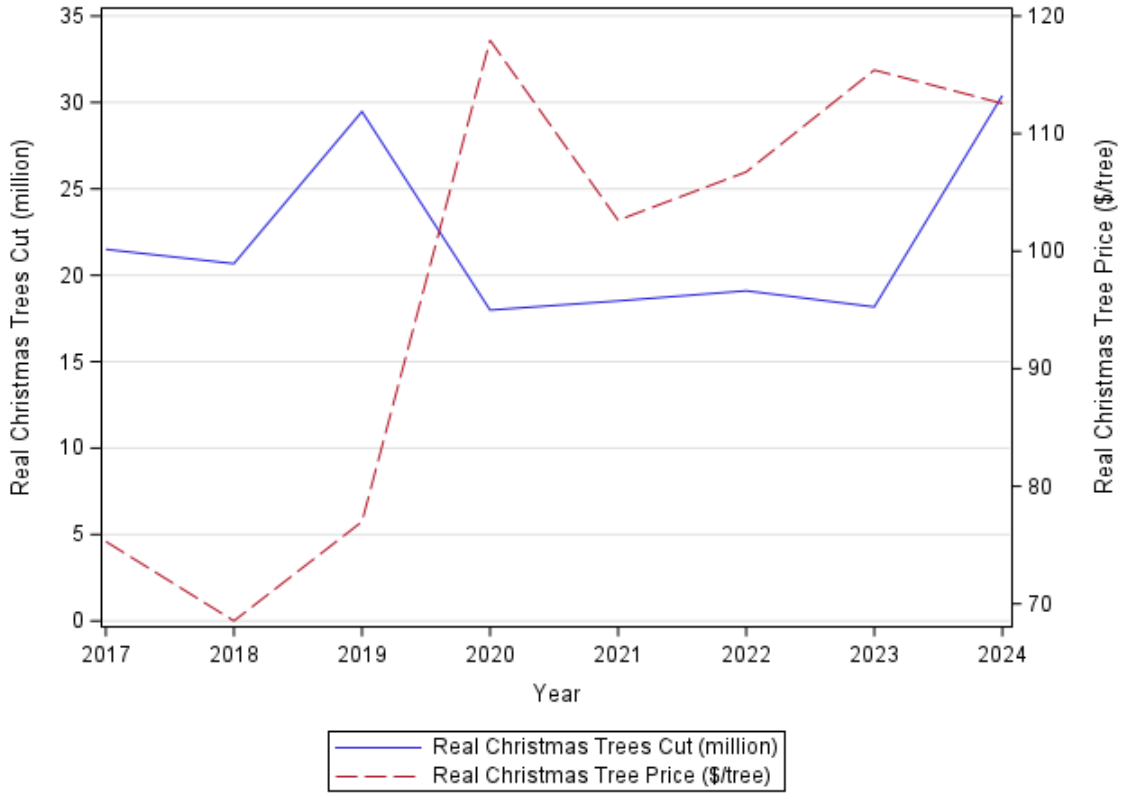
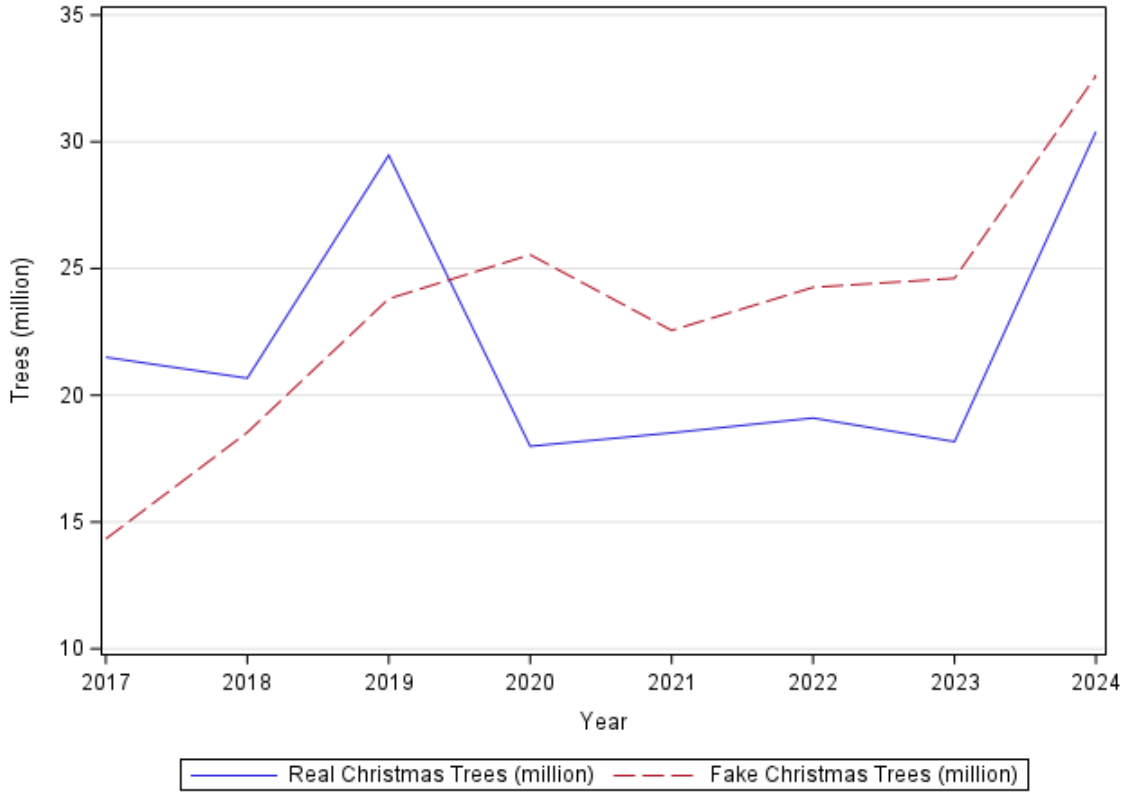


Figure 2. Real and Fake Trees Purchased, by Year



data consists of estimated impressions, or the "reach" of each marketing campaign, which are our chosen measures of marketing intensity, and dollars invested in each of three areas: Public relations, video, and social media. We allocate each campaign and the associated numbers of impressions and dollars to an activity category by carefully studying all documents provided to us and categorizing each activity into one of the three types of activity above. As RCTB activities move more toward social media and public relations activities, it is increasingly difficult to separate impressions into these different categories in a clean way because public relations events tend to become social media events over time. Regardless, we believe our categorization, although subjective, is at least directionally accurate. Categories of expenditure that are clearly related to administration, and not tied to any meaningful consumer-outreach activity, are therefore excluded from the analysis.

We understand that the NCTA survey is not widely trusted by industry members. However, in the previous evaluation we determined that this lack of trust is not due to the quality of the survey itself, but rather how it was interpreted by Harris Insight and Analytics staff. In their 2019 report, in which they analyze the survey data, they apply an average-purchase figure of 1.2 trees per household to estimate the total number of Christmas trees purchased in 2019 at some 32.4 million trees. This calculation, however, appears to include survey-respondents who were purchasing for either institutions or places of business, because the only way to arrive at an average purchase rate of 1.2 trees is to include respondents who purchased, sometimes, up to 20 trees. This is clearly unrealistic for forecasting purposes. We adjusted the data by trimming all unrealistic purchase-numbers from the data, and found that a more realistic estimate is 1.1 trees per household. Applying this purchase rate to the average purchase-probability, over all three years of the older survey data, of 18.6% produces an estimate closer to 26.2 million trees per year. We continue this process for the more recent survey-years used in this evaluation, and believe that the implied estimates are likely to be much closer to the actual number of trees cut each year. This cleaning process also validates the underlying survey as a reliable data source.

Moreover, the reliability of our econometric estimates does not rely on the accuracy of this average-number-of-trees response. Statistically, we are only interested in how variation in prices between respondents, and advertising between years, are related to the likelihood a respondent chose to display a real Christmas tree. As our results below show, these measures prove to be very accurate predictors (in a statistical sense) and suggest that the underlying survey is an effective tool for evaluating the performance of the RCTB marketing program.

Research Methods and Models

For the econometric analysis, our statistical approach consists of three modeling components: (1) a simultaneous model of product demand and supply, (2) a model of the product supply-chain that is used to translate changes in demand to changes in grower prices, and (3) an ROI model that expresses the net present value of marketing investments on an annualized, rate of return basis. Although our original intent was to estimate the model on a regional basis, the NCTA survey did not provide the type of geographic variation that would support this type of econometric analysis. The mathematical details of each model are provided in the appendix below, so we only provide an intuitive summary here.

Stage 1: Econometric Analysis of Demand

In the first-stage econometric model, the critical outputs are "elasticity" estimates that show the percentage change in demand for a 1 percent change in each explanatory variable – prices, demographic factors or indicators of marketing reach. Because investments made in each activity are expected to have long-term impacts on demand, we estimate both short- and long-run elasticities associated with each type of activity.[5] Advertising is expected to have long-run impacts on demand as consumers learn slowly over time, form attitudes that take time to develop, and remember ads from previous campaigns. Further, if a household intends to buy a real Christmas tree, but the artificial one they currently own is still functional, it may take time for the plastic tree to deteriorate enough for the household to decide that it has outlived its usefulness.

Our econometric demand model is intended to provide estimates of the independent effect of RCTB activities on Christmas tree demand, holding all other

[5]Typically, we have data on repeated choices by the same household, but the NCTA survey draws different samples each year. Without this "panel" structure to the data, we differentiate long- and short-run elasticities by appealing to the literature on dynamic-demand estimation. Our consensus estimate from previous analyses of this type are that the long-run response is approximately 2.7 times as large as the short-run response.

factors such as price, household income, age, education, household size, urban / suburban, and homeownership status constant. This model is intended to answer the question "What would Christmas-tree demand have been in the absence of RCTB activities?"

Stage 2: Retail-Farm Price Linkage

Higher demand does not necessarily translate dollar-for-dollar into stakeholder revenue. In fact, marketing elasticities are necessarily estimated at the market level, while growers are more interested in incremental revenue to their businesses. Therefore, the econometric model also includes a set of relationships that are used to simulate the extent to which retail demand is passed through to higher stakeholder income. Because there is no published research on the rate and extent of pass-through from retail prices to wholesale (tree-farm-level) prices, we assume the farm-share-of-the-retail dollar is the same as that for other commodities with short supply chains, or 28.0%. See the technical appendix for details on this assumption.

Stage 3: Farm Profit Calculation

The primary output of the study will be a return on investment (ROI) for each marketing activity funded by the RCTB. ROI is calculated as the ratio of the net present value (NPV) of incremental profit generated by RCTB marketing activities, calculated over a simulated ten-year time horizon (a normal investment horizon), to the total amount of marketing funds invested in a given year. Although the mathematical details of how incremental profit and NPV are calculated are in appendix B below, the intuition is straightforward. Incremental profit is the difference between higher revenue generated from the combination of higher volume, higher prices, or both, created by a positive shift in demand and the sum of production and distribution costs. The ROI ratio is expressed on an annualized, rate of return basis in order to remain as comparable as possible to returns stakeholders can expect on other investments, such as capital invested in their growing operations or in external capital markets.

Stakeholder focus is necessarily long-term in nature. By estimating both short- and long-run demand elasticities, our model generates both short- and long-run changes in profit. In the long-run calculation, however, we also allow for the fact that stakeholders are likely to increase the supply of trees in response to higher returns, and reduce them as a result of the fee used to finance the RCTB. As a result, the long-run price impact of any marketing or research activity will be limited by the cost of production, or by the negotiating ability of individual growers.

Results and Discussion

In this section, we first present and interpret our demand-estimation findings using the data from the NCTA data, and then the implications for the ROI to each type of activity, and the overall performance of the RCTB marketing program. We then discuss the implications of our findings relevant to our primary goal, that is, determining the effectiveness of RCTB marketing programs. We infer marketing effectiveness in the NCTA survey by estimating differences in purchase behavior across time periods due to changes in each RCTB activity, but we caution that there is no direct measure of marketing perceptions in the NCTA survey.

NCTA Survey Data Summary

We first summarize the data representing the variables of primary interest from the NCTA survey. For the econometric analysis, we include all survey years (2017 - 2024) but focus on the 2020 - 2024 period for our evaluation estimates. In table 1 below, we show the mean and standard deviation of the probability a subject reported displaying a real Christmas tree, and the prices of real Christmas trees over the most recent four-year span of the NCTA survey. Table 1 also provides a summary of the demographic attributes of real Christmas-tree purchasers over the 2021 - 2024 period, as well as a regional breakdown of purchasers and the channel throughout which they purchased real Christmas trees. According to the data in this table, the average probability a respondent chose a real Christmas tree was 19.0% (the variable "Share" in the table), and the price of an average real Christmas tree as $112.45.

In table 2, we show the number of impressions (in billions) for public relations, video, social media, and total marketing activity over the evaluation period. Each year, the RCTB produced over 1.2 billion impressions, with the majority defined as social media, and a declining presence in video.[6] In terms

[6] Our allocation among these three classifications was admittedly subjective. If the primary media was video-based, we defined the activity as "video" even though its content may have gone viral through social media. Regardless, these differences are subsumed in the aggregate classification of

Table 1: *Summary of Harris Survey Data: 2020 - 2024*

		2020 Survey		2021 Survey		2022 Survey		2023 Survey		2024 Survey	
	Units	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	Years	38.27	14.51	40.03	14.72	41.81	15.75	41.95	15.65	41.65	14.59
HH Size	#	2.67	3.05	3.29	2.73	3.22	1.48	3.35	2.13	3.21	2.36
House	%	0.65	0.48	0.72	0.45	0.79	0.41	0.67	0.47	0.64	0.48
Urban	%	0.38	0.49	0.37	0.48	0.32	0.47	0.39	0.49	0.38	0.49
Educ	Years	14.40	2.59	14.24	2.54	14.72	2.38	14.50	2.52	14.48	2.34
Income	$,000	86.12	65.37	80.28	63.43	113.56	74.16	99.75	69.75	101.61	69.01
Gender	% M	N.A.	N.A.	0.49	0.50	0.53	0.50	0.50	0.50	0.55	0.50
NE	%	0.26	0.44	0.25	0.43	0.25	0.43	0.23	0.42	0.23	0.42
MW	%	0.16	0.37	0.15	0.36	0.21	0.41	0.20	0.40	0.17	0.38
South	%	0.33	0.47	0.42	0.49	0.36	0.48	0.42	0.49	0.36	0.48
West	%	0.25	0.43	0.19	0.39	0.19	0.39	0.15	0.36	0.24	0.43
Own Cut	%	0.10	0.30	0.12	0.33	0.12	0.33	0.12	0.33	0.13	0.33
Pre Cut	%	0.16	0.36	0.15	0.36	0.19	0.39	0.13	0.34	0.18	0.39
Lot	%	0.19	0.39	0.16	0.37	0.16	0.37	0.15	0.36	0.16	0.36
Non-profit	%	0.06	0.23	0.07	0.26	0.08	0.27	0.13	0.33	0.07	0.25
Nursery	%	0.17	0.38	0.12	0.32	0.17	0.37	0.16	0.37	0.17	0.38
Chain	%	0.20	0.40	0.29	0.45	0.19	0.40	0.21	0.41	0.22	0.41
Online	%	0.09	0.29	0.06	0.23	0.07	0.26	0.06	0.24	0.04	0.20
Number	#	1.25	0.44	1.13	0.33	1.17	0.38	1.19	0.39	1.21	0.41
Share	%	0.14	0.35	0.14	0.35	0.15	0.35	0.14	0.35	0.19	0.39
Price	$	114.53	22.91	128.86	25.77	106.68	21.34	115.34	23.07	112.45	22.49

Note: All data from 2020-2024 Harris-National Christmas Tree Association surveys. Sample size is approximately N = 2,000 each year. Mean is the arithmetic average of each variable and "SD" is the standard deviation. "Share" is the probability that a household purchases a real Christmas tree, which is the same as the market share in aggregate. For 2024, the number of US households is 132.28 million and the average number of trees per household is 1.21 for conversion to total tree numbers.

of dollars, the data in table 2 show that the RCTB allocated the greatest share of its budget to social media activities, and examining the data year by year suggests that the allocation to social is growing, as expected.

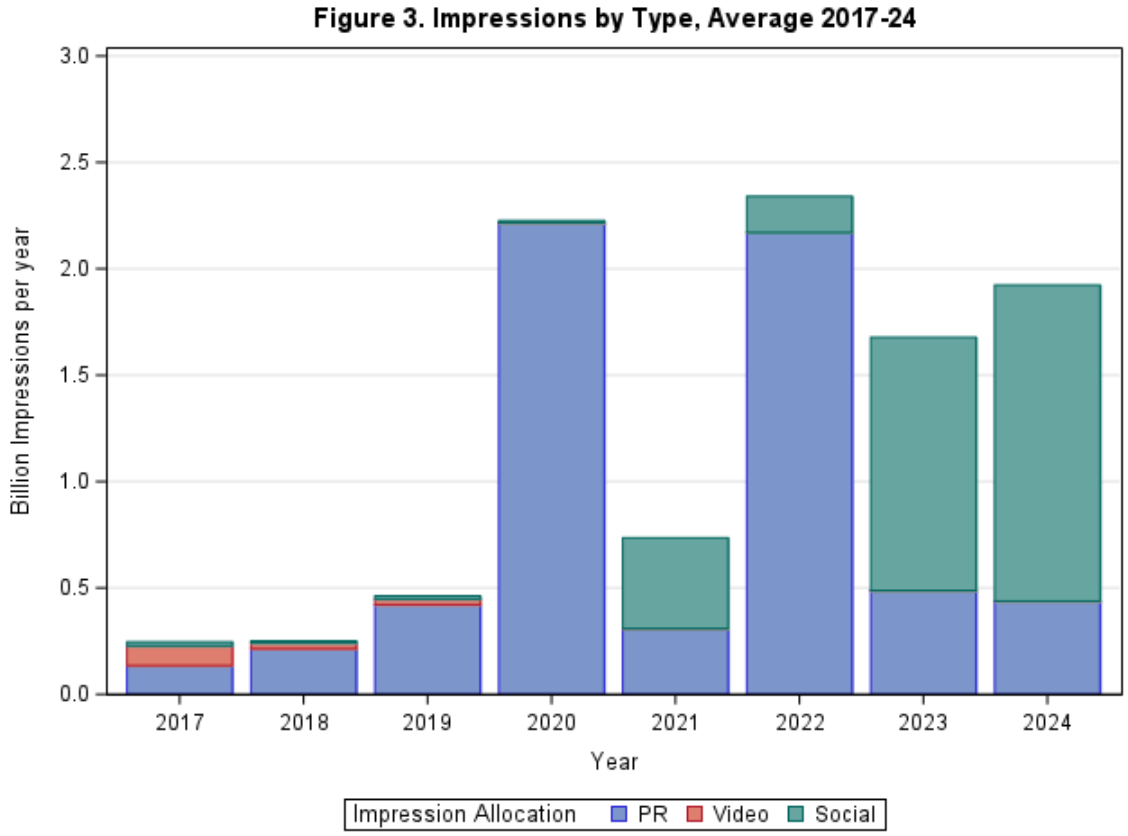
Figure 3 shows how impressions vary by activity over our sample period. The data reveal substantial changes in marketing strategy from year to year, which also helps in econometric identification as a natural test of which type of marketing is likely to work best. Over time, the data show that the RCTB has become increasingly reliant on public relations and social media, and all of its variants, which is likely to be expected given the general evolution of consumer behavior and media preference.

Table 2: *Summary of RCTB Activity Data*

	Impressions	Dollars
Public Relations	1.124	$571.45
Video	0.004	$23.67
Social Media	0.657	$424.64
Total	1.781	$1,019.80

Note: All data from 2020-2024 RCTB internal records. Impressions are in billions, and investment amounts in thousands of dollars, and represent annual averages over the 2020-2024 sample period.

"Total" impressions where we simply add all three types of impressions.



Estimation Results

We estimate Christmas-tree demand using the econometric model described above. Based on the estimates from this model, we calculate response elasticities with respect to the retail price and RCTB marketing activities, and summarize these elasticity estimates, both short-run and long-run, in table 3. Most importantly, the short-run price elasticity is approximately -0.254, which suggests that the demand for real Christmas trees is relatively inelastic, or consumers are somewhat insensitive to variation in prices when choosing Christmas trees. Our estimate is substantially more inelastic than in the 2020 report (-0.432) which suggests that consumers are becoming less sensitive to real Christmas tree prices over time. Elasticity is an important concept and, in the context of the 2025 estimate, means that if real Christmas tree prices were to rise by 10 percent, everything else constant, the retail quantity demanded would fall by only 2.5 percent. Finding inelastic demand is perhaps not surprising because there are few alternatives to real Christmas trees for consumers who want an authentic Christmas experience.

All of the marketing-mix elasticities are statistically significant, and positive, which means that each activity – independent of the others – has a positive effect on demand. Recall that we ran individual mod-

Table 3: *Retail Demand Model Estimates*

	Short-Run	Long-Run
Price	-0.254	-0.692
Total	0.002	0.143
PR	0.031	0.085
Video	0.021	0.055
Social Media	0.011	0.028

Note: All estimates generated by applying the logit demand models described in the appendix to the 2020-2024 RCTB Harris-National Christmas Tree Association data, assuming a lag parameter of 0.375 to differentiate short-run from long-run demand. All estimates are elasticities and are derived from the structural estimates using the formulas given in the appendix. All estimates are averages over the 2020-2024 sample period.

els with each type of marketing activity on its own (Public Relations, Video, and Social Media), and ran another model in which all three were combined. For evaluation purposes, we use this latter estimate to calculate BCRs because the estimates from the individual-activity models are interpreted as only "partial" effects, or telling only part of the story on their own.

Figure 4 shows all of these elasticity estimates in graphical form. In terms of the individual types of activity, our short-run elasticity estimate with respect to public relations activities is 0.031, and the long-run elasticity estimate is 0.085. Both the short-run and long-run estimates are slightly lower than those found in the 2020 evaluation report. These estimates mean that a 10 percent increase in public relations marketing intensity, as measured by impressions, can be expected to lead to a 0.31 percent increase in retail Christmas tree volume in the short run and a 0.85 percent increase in the long run. For video communications, we find a short-run elasticity of 0.021, and a long-run elasticity of 0.055, which are both almost identical to their 2020 estimates (0.019 and 0.053, respectively). With respect to social media, the short-run elasticity estimate is 0.011, and the long-run estimate was 0.028, which are slightly lower than their 2020 estimates (0.024 and 0.064, respectively).

Given that social media messaging is growing in importance (see figure 3), and that we account for diminishing marginal returns to investing in each activity, it is perhaps not surprising that the elasticity with respect to social media impressions is the lowest of the three categories. However, the fact that the response elasticity with respect to social media is still positive and statistically significant is important because it means that the activity that is growing fastest in importance, both in terms of dollars and reach, is still likely generating a positive return. Because of the diminishing marginal returns to any type of promotional activity, we would expect that higher levels of any one activity would be associated with a lower marginal impact if the incremental returns to any single mode of communication decline with the level of saturation. These estimates suggest that social media investments, while a relatively large share of RCTB activities, are not yet at this level of saturation. That said, PR remains the single "largest" activity in terms of impressions and it still generates the highest elasticity-response of any activity, so PR is likely not yet at this saturation threshold either. Subsequent analyses with more NCTA data may support this conjecture. Regardless, these elasticities suggest that each activity likely had a positive return to stakeholders over the 2020 - 2024 evaluation period. We return to this question next.

Table 4: *RCTB Marketing Activity BCR Estimates*

	Short-Run	Long-Run
Public Relations	9.174	17.248
Video	2.609	4.905
Social Media	4.899	9.222
Total Marketing	6.976	13.116

Note: All estimates generated by applying the logit demand estimates in table 3 to the grower-level profit model described in the appendix over the 2020-2024 RCTB Harris-National Christmas Tree Association data. All estimates assume a grower share of retail price of 27.0%, based on USDA estimates for other commodities, so represent conservative estimates if the grower share of retail revenue is higher than this estimate.

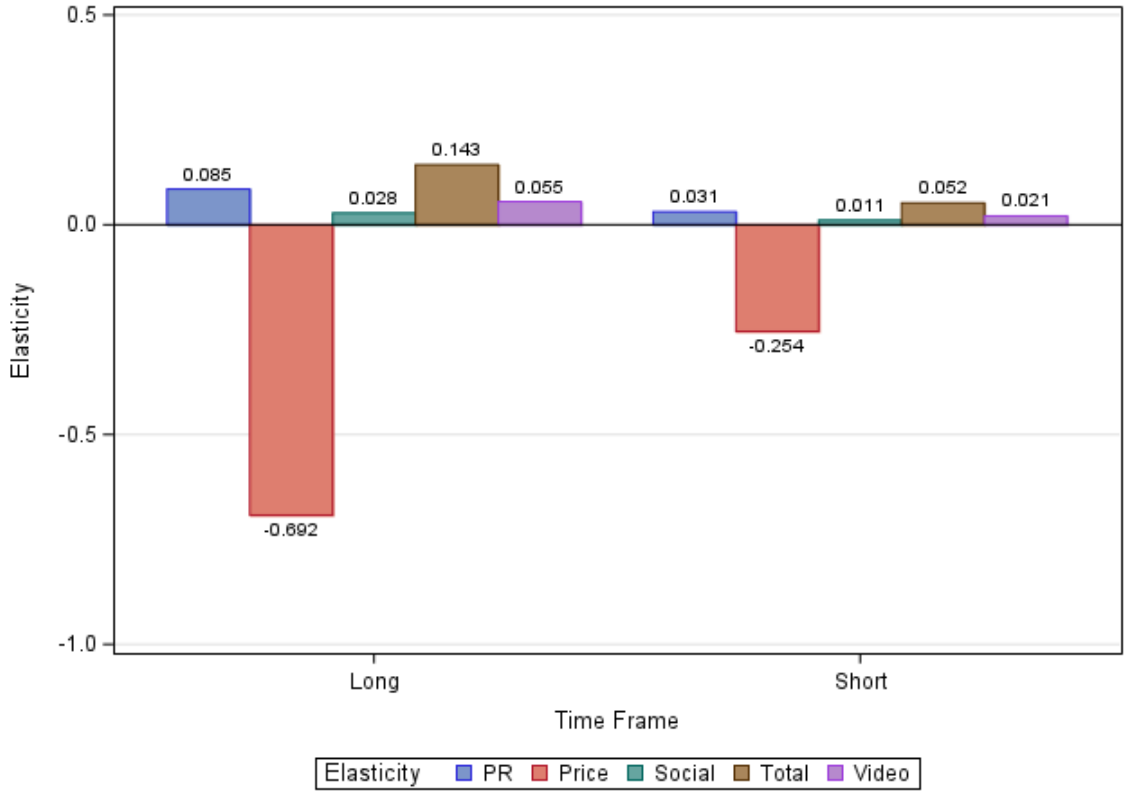
Returns to Marketing

In this section, we present and explain the returns to marketing investments, both in the short and long runs. Due to the expected long-term nature of marketing impacts, we calculate present value of incremental profit over the sample period for both the BCR and ROI measures. Taking the entire future stream of profit due to an investment into account in each period is important because any marketing investment is expected to have long-term demand effects, either due to inertia, learning, memory, or building some form of "brand equity" in the real Christmas tree concept.

Our calculations provide estimates of the marginal return, as opposed to the average, as growers and shippers are interested in the return on the next dollar invested when making budget allocation decisions. In this study, we calculate BCRs and ROIs for each type of marketing activity in the retail market over a range of possible supply elasticities, from 0.25 to 1.5 with the most-likely value 1.0. We report these most-likely BCR values in table 4 and figure 5 below. The ROI values for other supply elasticities show a similar pattern, so are not included in the table. In general, returns fall as the elasticity of supply rises (price effects are muted with more elastic supply) and, given that empirical estimates of most commodity-supply elasticities are substantially lower than 1.0, our estimates are relatively conservative.

From the results reported in table 4 and figure 5, we see that all activities generate positive returns in

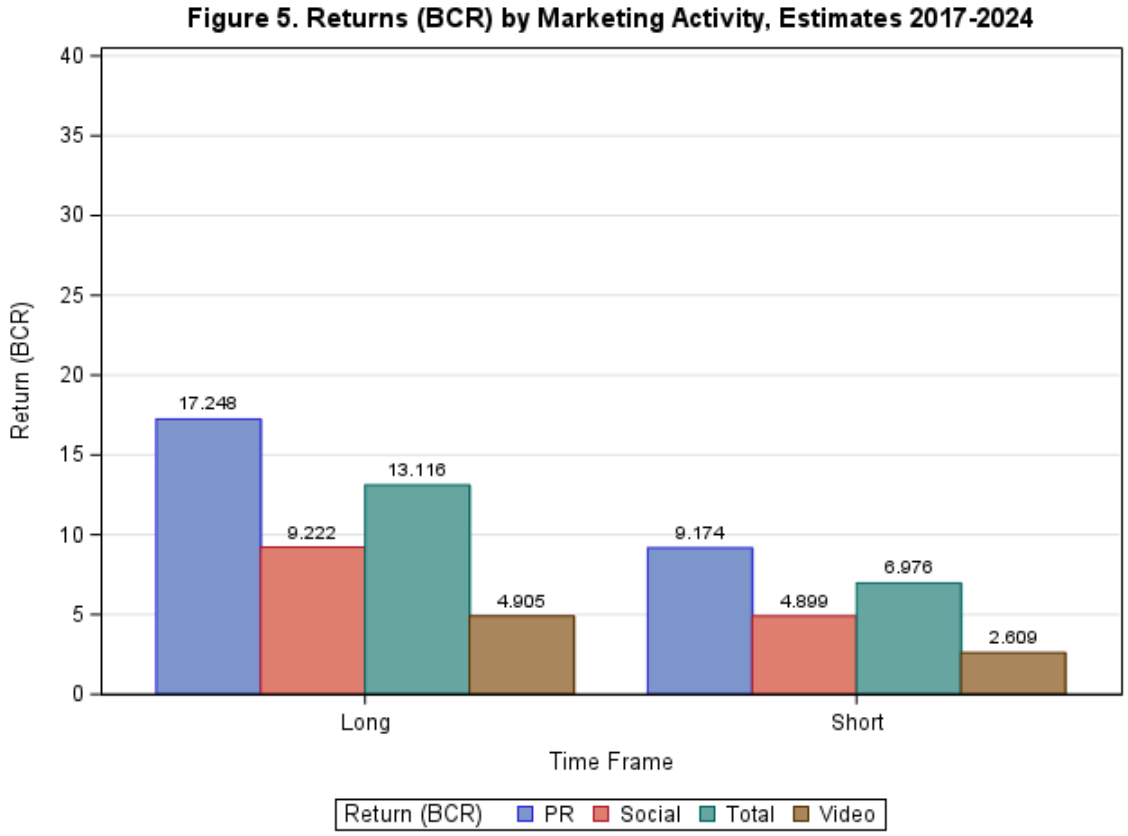
Figure 4. Response Elasticities, Estimates 2017-2024



the long-run as all BCR values are above 1.0. A BCR greater than 1.0 means that an activity generates more dollars in incremental value (present value of future profit) than the investment cost. Overall, when we calculate the BCR with respect to aggregated-activities, that is, the sum of video, social media, and public relations impressions, we find a short-run BCR of 6.976, and long-run BCR of 13.116. Both of these estimates are slightly lower than their corresponding values from the 2020 evaluation. Our most recent estimates imply that the next dollar invested in any activity can be expected to produce $6.97 in net profit (present value) in the short run, and over $13.11 in the long run. The ROIs implied by these BCR estimates are 597.6% and 1,211.6%, respectively. While these estimates may seem high, they are consistent with other check-off program estimates (Williams et al. 2018). Particularly due to the fact that the RCTB program is relatively small (compared with the Beef, Pork and Dairy programs), and the fact that generic promotion programs tend to exhibit diminishing marginal returns, the magnitude of these estimates is not surprising at all.

With respect to individual activities, the estimates in table 4 and in figure 5 show that public relations impressions generate the highest BCRs of 9.174 (ROI = 817.4%) in the short-run, and 17.248 (ROI = 1,625%) in the long-run. Both of these estimates are nearly identical to our estimates in the 2020 evaluation, despite the fact that public relations activities now comprise a much larger share of total RCTB marketing programming (see figure 3). Due to the declining marginal benefits to marketing, reducing the size of a particular activity is likely to increase its marginal return, provided that it is still effective. Our estimates in this regard mean that funds invested in public relations generate over $9 of incremental value (present value of profit) for every dollar invested in the short-run, and over $17 in the long-run. Equivalently, the ROI estimates imply that the same investment would be viable with any reasonable hurdle rate of return, in either the short or long runs. Because most growers are presumably invested for the long-run, for practical purposes the long-run estimate is more meaningful, and suggests that investments in public relations activities are highly profitable.

Returns to each of the other activities show a similar pattern, albeit slightly lower than either the aggregate or public relations estimates. In the short run, for example, social media activities (BCR = 2.609, ROI = 160.9%) and video investments (BCR = 2.609, ROI = 160.9%) still produce returns that are very high, and easily over the typical grower's



returns on capital invested in any other activity. This result is significant, given the relative importance of social media messaging among all RCTB activities.

As we explained above, commodity-program managers make optimal use of their limited check-off funds when the marginal returns to all activities are equalized. For example, if the marginal BCR in public relations investments is 17.248 in the long run, for example, and the marginal BCR in video is 4.905, then moving one dollar from video to public relations "costs" only $4.91, but produces a return of $17.25. Therefore, there is a roughly $12.00 gain in moving investments from video to public relations. Because there are diminishing marginal returns to each activity, the act of moving funds from video to public relations will result in the marginal return to public relations to fall, and the return to video to rise, until the two are equalized at the optimal allocation. However, we emphasize that the RCTB has moved substantially away from producing video, and our estimates only reflect the fact that 2020 activities remain in our data. This example is only conceptual. While determining the exact allocation is beyond the scope of this analysis, the recommendations are clear. That is, grower value is increased by reallocating budget from video to public relations and social media activities.

In summary, we find that all Christmas tree marketing activities are profitable in the short run and long runs (BCRs are greater than 1.0). Because we measure return on investment in terms of the profit expected on the last dollar spent, our results suggest that Christmas tree production and marketing would be significantly more profitable if more dollars were allocated to each activity. If marketing budgets are fixed, then our findings suggest re-allocating funds toward public relations activities. From a longer-term perspective, however, we caution that our estimates are only as good as the NCTA data, so we also suggest developing a system to gather data directly from suppliers, or from point-of-sale technologies. These data would be helpful not only in future RCTB evaluations, but in optimizing both advertising expenditures, and pricing levels.

Conclusions and Recommendations

Purchases of real Christmas trees rose over the study period (2020 - 2024), as did prices for real Christmas trees, so our underlying data suggests that real Christmas tree growers were likely better off than they were in 2020. However, this study seeks to determine the RCTB's role in increasing demand for

real Christmas trees. Specifically, we use survey data from 2017 - 2024 to investigate the return on investment for grower-shipper dollars invested in all RCTB marketing activities, including public relations, video, and social media marketing programs. Because many factors other than marketing activities can explain changes in demand over time, the specific role of the RCTB in helping maintain consumer demand is an important, and empirical question.

Using the NCTA survey data, we find that all RCTB activities were effective in raising demand when controlling for the effect of prices, fake Christmas tree prices, consumer demographics, consumer income, and other factors relevant to the demand for real Christmas trees. Among the types of activity reported in RCTB budget data, we find that public relations investments were particularly profitable in the Christmas tree market, dominating the return to all RCTB marketing activities. However, we caution that this may be due to the fact that public relations and social media activities have a substantial interaction effect, namely that many public relations events become social media activities after going viral via social media platforms. Investments in video productions were the least profitable, which likely explains why the RCTB is moving away from producing their own videos. However, video still provides a rate of return well in excess of any alternative investments that may be available to growers. In general, all activities are highly profitable in the long-run, which should be the focus of RCTB marketing activities.

In arriving at these conclusions, we recognize that the quality of our findings are inevitably limited by the quality of the data. This problem is not unique to the RCTB analysis as there are virtually no agricultural marketing boards that collect data for the specific purpose of evaluating their marketing programs. While the NCTA data describing consumer purchases of real Christmas trees are widely regarded as inaccurate, we maintain that this is due to how they are aggregated out to create a market estimate, and not due to fundamental problems with the survey itself. As in the last evaluation, we recommend that the RCTB develop a method of generating retail-sales data from cooperating Christmas tree vendors. Survey data are always useful for understanding consumer behavior, but "revealed preference" data gathered from actual retail sales remains the gold standard for any market-level analysis such as this.

In terms of specific programs, we find that investments in public relations activities appear to be far more profitable than either investments in video or social media, although video is now a relatively small activity. While we recognize that complementary investments are often necessary as no Board can "put all its eggs in one basket," if we apply the standard that the marginal return to each activity should be equal if the budget is allocated appropriately, it appears that the RCTB could allocate more budget to public relations, and increase the demand for real Christmas trees even further.

Appendix A: Econometric Model

This appendix describes in more detail the specific econometric models that was used in estimating the impact of RCTB marketing activities on the demand for real Christmas trees in the U.S. For this analysis, it is assumed that there is only one market for Christmas trees, although we realize that the market is likely to be highly local. This assumption has no material impact on our findings.

In this model, the primary objective is to estimate the demand impact of RCTB video, social media, and public relations activities on Christmas tree sales. In each case, we measure the "intensity" of marketing activity as the number of advertising impressions associated with each, as reported by RCTB internal records.

For this purpose, we used a random coefficient logit demand model, which well-accepted for this purpose in the literature on generic-promotion program evaluation. This model tends to produce robust parameter estimates without the inflexibility of a theory-based demand system. The model is estimated by pooling over individual survey respondents, with the random-coefficient element allowing for unobserved heterogeneity in both price and advertising responsiveness. In this model, the "dependent variable," or the variable that we explain, is defined as the probability each household purchased a real Christmas tree in the NCTA survey. Aggregating over all households, this measure provides an average probability that a typical household purchases a real Christmas tree each year. Multiplying this probability by the number of trees per household, and the number of households in the US, provides an estimate of the total number of real Christmas trees sold in the US each year.

In this model, the set of explanatory variables includes the price paid for the tree, whether real or artificial, the level of reported income, age, education, household size, urban / suburban, and whether or not the household owns their own home. We include measures of total advertising intensity (sum of impressions generated by video, social media, and public relations) to capture the impact of RCTB promotion activities.

Algebraically, this model is written as follows:

$$Pr(r_{jt} = 1) = exp(\delta_{jt})/exp(1 + \delta_{jt}),$$

where $Pr(r_{jt})$ is the probability that a typical household buys product j (either a real or artificial Christmas tree) in year t, with mean utility given by:

$$\delta_{jt} = \alpha_j + \beta_j p_{jt} + \sum_l \phi_l A_{lt} + \sum_k \gamma_k Z_{jk},$$

and p_{jt} is the price of product j sold during year t, A_{lt} is an indicator of marketing effort with respect to activity l during year t, and Z_{hk} is a set of other explanatory variables that vary by household h, including personal income, education levels, age, household size, urban / suburban, and whether the household owns their home. The price parameter is assumed to be normally distributed with zero mean and variance to be estimated with the data so that:

$$\beta_j = \beta_0 + \sigma_\beta \nu_\beta,\ \nu_\beta \ \ N(0,1).$$

With this model, the impact of each activity l on sales of product j is calculated as:

$$\phi_{jl} = \frac{\partial Pr(r_{jt})}{\partial A_{lt}} \frac{A_{lt}}{Pr(r_{jt})},$$

which is interpreted as the percentage change in sales for a 1 percent change in change in expenditure on activity l.

Appendix B. Grower Profit Model

This appendix describes the way in which we will calculate the increment to total grower profit given the impact parameters estimated in the demand model above. This model is similar to one used in Richards and Patterson (2000) and was originally developed by Kinnucan et al. To calculate profit, the analysis takes into account: (1) the activity impact on demand quantity sold to consumers, (2) the impact on price, (3) the feedback effect of higher prices on market supply, and (4) the transmission of retail prices to the grower level. Although the final solution consists of a single equation, the model requires separate components for each element (1) to (4). Again in mathematical terms, this model, written in terms of the change in the log of each variable value, appears as:

- Market Demand: $dlnQ_r = N_r dlnP + G dlnZ_r + B_1 dlnA_1 + B_2 dlnA_2$,
- Import Demand: $dlnQ_m = N_m dlnP + H dlnZ_m$,
- Farm Supply: $dlnX = E_s dlnW$,
- Price Transmission: $dlnW = T dlnP$,

- Market Equilibrium: $w_m dlnQ_m + w_r dlnQ_r = dlnX$.

In this case, we assume import demand is negligible, so set the equation equal to zero in the simulation model. Each equation is then substituted into market equilibrium to solve for the resulting price impact of the marketing program:

$$\begin{aligned} dlnP =& M^{-1}GdlnZ_r + M^{-1}HdlnZ_m \\ &+M^{-1}B_1 dlnA_1 + M^{-1}B_2 dlnA_2, \end{aligned}$$

Given this change in prices, the addition to profit is then calculated as:

$$d\pi = \Sigma_i S_{fi} P_i Q_i dlnW_i (1 + 0.5 dlnX_i). \quad (1)$$

where $d\pi$ is the change in profit, and the subscript indicating activity l has been suppressed for clarity. Each of the variables and parameter values are defined as follows:

- W = variables representing FOB (grower or farm) prices for each product;
- X = variables representing supplies of each product;
- P = variables representing market prices (assuming export and retail prices are equal);
- Q_r = variables representing retail quantities;
- Q_x = variables representing import quantities;
- w_r = share of market in retail;
- w_x = share of market in import;
- S_{if} = grower's share of the retail dollar for the ith product type;
- Z_r and Z_x = factors affecting demand in retail and import markets,
- A_1 = indicator variable for marketing activity 1;
- A_2 = indicator variable for marketing activity 2;
- N_r and N_x = groups of retail and import demand price-response terms;
- B_k = response measures for the kth type of activity;
- T = price-transmission elasticities (percent of price going to grower);
- G = demand elasticities with respect to exogenous retail factors,
- H = elasticities with respect to exogenous import demand shifters;
- E_s = supply response elasticities;
- $M = E_s T - w_r N_r - w_x N_x$ = solution for the change in price variable.

This model, while appearing quite complicated, is easily implemented with any spread sheet or data base software. Based on the incremental profit calculated in the profit equation above, the net present value of investment in activity l is calculated as:

$$NPV_l = \sum_t e^{-rt} d\pi_{lt} - c_{lt},$$

where e^{-rt} is the "present value factor" that is used to calculate the present value of incremental operating in year t at time 0 at a discount rate r, c_l is the amount of expenditure on activity l and summing over a ten year period reflects the assumed long-range planning horizon of the RCTB. If NPV_l is greater than zero at an interest rate that reflects RCTB members' opportunity cost of capital, then investments in activity l are economically viable.

While NPV is a valid investment-evaluation criteria on its own, this equation will also be used to generate benefit-cost ratios (BCRs) in order to maintain comparability with other studies, and with evaluation standards in the industry. In terms of the NPV calculation equation, a BCR for each activity is calculated by simply taking the ratio of the present value of incremental profits to the cost of each activity. If this value is greater than 1.0, then the activity generated positive value for growers. A return on investment (ROI) estimate is then formed by calculating:

$$ROI = (BCR - 1) * 100,$$

with the result expressed as an annualized percentage rate of return that is directly comparable to returns on other investments. For example, if an activity generates a present-value of benefits of 2.5 million dollars, on an investment of 1.0 million dollars, the BCR is 2.5. In other words, the next dollar invested in promoting Christmas trees using this activity can be expected to generate 2.5 dollars in incremental (present value) profit. Expressed differently, this

BCR of 2.5 implies a ROI of 150 percent, which would clearly be preferred to growers who average, say, 10 percent on alternative investments.

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