Christmas Tree Promotion Board Evaluation Report

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Real Christmas tree demand in the U.S. has shown a substantial rise over the 2016 - 2019 study period. While general economic growth may have played a role, marketing activities funded by the Christmas Tree Promotion Board (CTPB) are also likely to have had a substantial impact. In this report, we summarize our findings from an econometric analysis of Board marketing activities.

Executive Summary

- Project Objectives: The primary objective of this evaluation was to estimate the long-run impact of Christmas Tree Promotion Board (CTPB) promotion activities, defining promotion to include all public-relations, video and social-media outreach over the 2017-2019 seasons, on the demand for US Christmas trees, and to use these impact estimates to calculate the return on investment (ROI) for all stakeholders.

- Study Design: We used econometric methods to disentangle the effect of CTPB 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 was the National Christmas Tree Association (NCTA) survey, which we supplemented with a new choice experiment, conducted through the online Qualtrics survey platform. We used CTPB records to measure the intensity of each promotion activity over the previous 3 year period (detailed data for 2016 were not available). Using this data, we estimated a series of econometric models intended to quantify the relationship between CTPB 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: We understand that there are 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, but this implied number is based on a calculation that includes survey-respondents who report purchasing up to 20 trees per year. If we exclude those households, the average number of trees purchased is more realistic, and the total number of trees purchased is more reasonable (although still high relative to the Census of Agriculture). Regardless, the raw data from the

survey provides a reliable guide to the factors that cause consumers to purchase trees: Prices, point-of-sale, tree height, and other important factors. As we should below, the statistical model we applied to the NCTA survey data provide an excellent fit to the raw survey 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 CTPB promotion activities, both in the short and long-runs. We found a short-run price elasticity of demand for Christmas trees of -0.432, and a long-run price elasticity of -1.178, 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 0.085 and a long-run elasticity of 0.232. The short-run estimate implies that a 10 % increase in promotion activity will result in a 0.85 % 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 CTPB promotion activities. We find that the short return benefit:cost ratio (BCR) to total CTPB advertising impressions is 13.110 and the long-run BCR is 21.701. These estimates suggest that one more dollar invested in promotion activities can be expected to generate an additional $13.11 in grower profit in the short run, and $21.70 in the long run. Both suggest that grower investments in the CTPB are highly profitable as the short-run ROI is 1,211% in the short run and over 2,000% in the long run. Both values are clearly well above growers' opportunity cost of capital.

- Qualtrics Survey: We conducted a survey, or "choice experiment," in order to validate the price- and advertising-elasticity estimates from the NCTA survey data. Our survey is referred to as a choice experiment as we ask respondents to make actual purchase decisions instead of simply asking them to report their purchase history or intentions. The experimental data reveals a strong preference for real Christmas trees. Moreover, the results from this survey corroborate the inelastic demand for real Christmas trees, and the strong impact of CTPB promotion activities. In this experiment, we tested the effect of 2017, 2018, and 2019 campaign materials on the likelihood of purchasing a real Christmas tree, relative to a no-advertising scenario. We find response elasticities ranging from 0.024 to the "Farmers" campaign of 2017 to 0.047 for the "Families" campaign from 2018. All BCRs estimated with the Qualtrics data are in excess of 20.0, meaning that the next dollar invested in programs like this can be expected to generate $20.00 of incremental grower profit (measured in present-value terms).

- Data Recommendation: We find that the NCTA survey is a valuable source of demand data, but the CTPB would be well served to devise a method of gathering either retail-sales or grower-shipment data. Data like this would both facilitate future analyses like this one, and allow CTPB 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 CTPB advertising campaigns, and perhaps test image recall and awareness.

Introduction

According to the Census of Agriculture (USDA-NASS 2017), the number of Christmas trees harvested between 2002 and 2017 fell from 20.8 million to 15.1 million trees. Over the same period, the total number of farms producing trees fell from 21,904 to 15,008, and the total acreage in trees from 447 thousand acres to just over 295 thousand acres. While this 15-year period included the Great Recession that began with the financial collapse of 2008, it ended during a period of relatively strong economic growth. For most consumer goods, economic growth should mean greater demand. But, sustained growth is never guaranteed, and declining sales are particularly problematic in industries with large up-front investments, long planning horizons, and deeply competitive industry members. Therefore, the economic rationale for promoting Christmas trees as a category is easy to understand. However, the actual economic impact of such broad-based promotion is an empirical question.

As required by the Federal Agriculture Improvement and Reform Act of 1996, all federally sanctioned marketing orders 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 CTPB managers make more efficient use of stakeholder check-off funds. Specifically, we estimated the marginal effect of impressions on demand from video, social media, and publicity activities. 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, and the relative lack of history in promoting, and in conducting research, on the Christmas tree market.

Objectives

The primary objective of this research is to estimate the long-run effectiveness of CTPB promotion and research activities over the 2016 - 2019 period. Due to limitations imposed by the NCTA survey, however, we limit our empirical attention to the 2017 - 2019 period covered by the available survey data. 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.[1] Our research also generated a number of other outputs of interest to CTPB stakeholders, including estimates of:

- The long-run impact of CTPB 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 CTPB undertakes a wide range of outreach activities, we focus on broad classes for which the data are available: Video, social media, and public relations. In each case, we use econometric methods to control for potentially-confounding factor such as Christmas tree prices, and socio-economic attributes of the survey respondent;
- The long-run impact of CTPB marketing activities on prices paid to growers by Christmas tree retailers, wholesalers, or directly by consumers through an econometric simulation model of the 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 CTPB marketing activities;
- New baseline consumer-purchase intentions generated by an online choice experiment conducted through the Qualtrics survey platform. This experiment is intended to provide data on ad preferences, and how purchase behavior is likely to be influenced by variation in prices, advertising campaigns, and various measures of consumer socio-economic and demographic attributes.

[1] Note that our initial objectives included determining the return to research investments, but there are no data available to estimate the impact of research spending on grower returns.

Data Sources

To achieve these objectives, we used the best data possible. There are no previous analyses of CTPB activities, so our primary demand data consisted of three prior NCTA surveys. Although the NCTA conducted surveys from 2016 - 2019, data were available in usable form for only the 2017 - 2019 surveys. We used the data from these surveys in raw form, which provided 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 included 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 environment.

The NCTA survey, however, only provides three "observations" for us to measure the relationship between advertising intensity, and demand. That is, the size of each program only varied from 2017 to 2018, and to 2019. Because we were initially concerned that this would not provide sufficient variation to estimate the impact of advertising activities on demand, we also conducted our own experiment using the Qualtrics survey platform. With an experimental approach, we were able to vary the type of advertising (e.g., base logo, the 2017 "Farmer" campaign, and the 2018 "Family" campaign images) as

well as price and other variables across a number of hypothetical choice scenarios. These choice scenarios provide some 24 data points for each of N = 2,000 experimental subjects, so provide a large number of data points to estimate promotion effectiveness. Further, we use the Qualtrics experiment data to estimate the price-responsiveness of Christmas tree consumers, and which Christmas tree attributes consumers prefer.

Data for the level or intensity of investment in each marketing activity by the CTPB were made available by CTPB staff. These data are of extremely high quality, with considerable detail, description, and quantitative measures of intensity. We went through all of the internal documents provided to us, and determined that there appeared to be three classes of activities that could be readily identified, and quantified in terms of its relative reach (measured by impressions) and level of investment: Video, social media, and public relations. In order to keep our analysis to a tractably-small number of different activities, while still conducting a comprehensive analysis of nearly all CTPB activities, we classified nearly all campaigns into one of these three groups. Categories of expenditure that were clearly related to administration, and not tied to any meaningful consumer-outreach activity, were therefore excluded from the analysis.

We understand that the NCTA survey is not widely trusted by industry members. However, 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 survey data, of 18.6% produces an estimate closer to 26.2 million trees per year. We understand that this is a more realistic estimate of the number of real trees actually sold, and 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 proved 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 CTPB marketing program.

Our Qualtrics survey helped to corroborate the usefulness of the NCTA survey, and provided another source of data in its own right. The Qualtrics survey is designed as a "choice experiment," which we used to gather data on how Christmas-tree choices are likely to be impacted by variation in prices, tree attributes, and different advertising campaigns. The Qualtrics surveyed also produced valuable data on respondents' subjective assessments of the relatively quality and effect of different ads created by the CTPB over the 2016 - 2019 study period.

The choice-experiment element of our Qualtrics survey uses an approach that is well understood in the marketing and economics fields, and is useful for providing data on purchase-intentions for which there is little secondary-data on actual purchases, such as from frequent-shopper cards or scanner data from retail stores.[2] We include the survey instrument itself as a deliverable with this report, but summarize how it works here. In a choice experiment, survey-subjects are presented with a number of hypothetical choice occasions, or "cards." Each card consists of four possible choices, plus a "none of the above" option. Each choice consists of a different type of Christmas tree, where trees are differentiated by four attributes: Real or artificial, price ($29.99, $49.99, $ 69.99, $89.99, $119.99, and $139.99), location of purchase (tree farm, garden center, box store, or online), and height (5 ft or under, 6 ft, 7 ft, 8 ft, or 9 ft or taller). Each subject made 24 choices, for a total of 48,000 choice observations. Although we recognize that these attributes, and the levels associated with each attribute, do not exhaust the full range of how Christmas trees can differ, we are confident that they capture enough variation in order to isolate subjects' intentions to purchase each type of tree, and how attributes influence their purchase-probabilities.

We gathered data on the impact of CTPB advertising by segmenting the sample into four different

[2]This approach is also known as "conjoint analysis" in the marketing literature

sub-samples (each consisting of 500 subjects, or one-quarter of the whole sample), and exposing each to a different "information" treatment. Each information treatment consisted of a different form of CTPB advertising message. Within the survey framework, it is not possible to expose subjects to a complete set of webpages, social media exposures, videos, or public-relations material, so we chose communications that represented what we regarded as the most important recent CTPB messaging. That is, 500 subjects saw the base "Keep it Real" logo, in full color, while a second group saw imaging from the 2017 "Farmers" campaign, a third saw imaging from the 2018 "Families" campaign, and the remainder saw nothing, serving as a control group against which to compare the effectiveness of the other three exposures. This sub-sampling, or between-subject, method was necessary because subjects cannot logically "unsee" an ad they have been exposed to. Therefore, we could not vary ad exposures to the same subject over their 24 choice occasions. This approach is a well-accepted method for evaluating the impact of different advertising media, and produces highly reliable estimates of the total impact of CTPB advertising on Christmas tree demand.

The Qualtrics survey also gathers data on a full set of demographic and socio-economic variables, and includes a small set of open-ended questions regarding respondents' awareness of CTPB promotion materials, and their perceptions of its quality (see survey instrument). With this data, we are able to provide more qualitative feedback on the likely effectiveness of CTPB programming.

Importantly, our survey included purchasers of both real and artificial Christmas trees. This information is critical as we intend to differentiate the the type of consumer who is likely to buy a real Christmas tree from the consumer who buys an artificial tree. Every non-purchaser is a potential purchaser, so understanding the size of this potential market is key in understanding the ability of CTPB activities to reach these consumers, and convert them to real Christmas tree buyers.

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.[3] 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 CTPB activities on Christmas tree demand, holding all other factors such as price, household income, age, education, household size, urban / suburban, and home-ownership status constant. This model is intended to answer the question "What would Christmas-tree demand have been in the absence of CTPB 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

[3] 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 (Richards 2016).

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, these estimates take the form of assumptions in the profit-calculation model drawn from our experience with other commodities with short supply chains (i.e., direct or near-direct sales to consumers).

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 CTPB. ROI is calculated as the ratio of the net present value (NPV) of incremental profit generated by CTPB 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 CTPB. 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 findings using the data from the NCTA data, and then the findings from the Qualtrics experiment. In each case, we discuss the implications of our findings relevant to our primary goal, that is, determining the effectiveness of CTPB marketing programs. That said, we caution that the surveys were designed for different purposes, and we evaluate marketing effectiveness in different ways in each case. While the NCTA survey was designed to measure display behavior by a nationally-representative sample of consumers, and to segment the Christmas-tree market, the Qualtrics experiment was designed specifically to estimate the price-responsiveness of Christmas-tree buyers, and the likely effectiveness of past CTPB marketing materials. We infer marketing effectiveness in the NCTA survey by estimating differences in purchase behavior across time periods when CTPB activity differed, but there is no direct measure of marketing perceptions in the NCTA survey. In order to ensure comparability between our findings in each case, however, we keep the econometric approach as similar as possible across the two different data sets.

Table 1: *NCTA Survey Data Summary*

	Units	Mean	Standard Dev.
Real Tree	%	0.186	0.389
Price	$	73.674	47.206
Total	Imp.	3.175	1.001
PR	Imp.	2.534	1.199
Video	Imp.	0.501	0.312
Social Media	Imp.	0.140	0.036

NCTA Survey Data

We first summarize the data representing the variables of primary interest from the NCTA survey. Table 1 shows the mean and standard deviation of the probability a subject reported displaying a real Christmas tree, the prices of real Christmas trees over the survey period, and the number of impressions (in hundreds of millions) for public relations, video, social media, and total marketing activity. According to the data in this table, the average probability a respondent chose a real Christmas tree was 18.6%, and the price of an average real Christmas tree as $73.67. Each year, the CTPB produced over 300 hundred million impressions, with the majority defined as public relations, and a relatively small presence in social media. We will return to the allocation of dollars among activities in the analysis below.

We estimated Christmas-tree demand using the econometric model described above. Based on the estimates from this model, we calculated response elasticities with respect to the retail price and CTPB marketing activities, and summarize these elasticity estimates, both short-run and long-run, in table 2. Most importantly, the short-run price elasticity is ap-

Table 2: *Retail Demand Model Estimates*

	Short-Run	Long-Run
Price	-0.432	-1.178
Total	0.085	0.232
PR	0.056	0.152
Video	0.019	0.053
Social Media	0.024	0.064

proximately -0.432, which suggests that the demand for real Christmas trees is inelastic, or consumers are relatively insensitive to variation in prices when choosing Christmas trees. A price elasticity of -0.432 means that if real Christmas tree prices were to rise by 10 percent, everything else constant, the retail quantity demanded would fall by only 4.3 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. Regardless, we aim to corroborate this finding with the Qualtrics survey data.

All of the marketing-mix elasticities were found to be statistically significant, and positive, which means that each activity – independent of the others – had a positive effect on demand. Recall that we ran individual models 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.

In terms of the individual types of activity, we found a short-run elasticity with respect to public relations activities of 0.056, and a long-run elasticity of 0.152. These estimates mean that a 10 percent increase in public relations marketing can be expected to lead to a 0.56 percent increase in retail Christmas tree volume in the short run and a 1.52 percent increase in the long run. For video communications, we found a short-run elasticity of 0.019, and a long-run elasticity of 0.053, and for social media, the short-run elasticity was 0.024, and the long-run estimate was 0.064. Given that public relations messaging is the most important activity, both by number of impressions and budget (table 1), finding a positive response is both important, and surprising, given the diminishing marginal returns to any type of promotional activity. That is, 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 public relations investments, while a relatively large share of CTPB activities, are not yet at this level of saturation. In fact, it may be the case that the other activities have yet to reach a "threshold level" of activity, meaning a minimum point required to establish mind-share among Christmas tree consumers. If the CTPB is able to gather more systematic, longitudinal data on tree sales, whether or not these threshold effects are important would be an issue worth investigating.

Returns to Marketing - NCTA

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 3 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. All BCR values are calculated using the demand parameters estimated above.

From the results reported in table 3, we see that all activities generate positive returns in 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

Table 3: *NCTA Model BCR Estimates*

	Short-Run	Long-Run
Public Relations	9.557	15.818
Video	4.787	7.939
Social Media	12.981	21.484
Total Marketing	13.110	21.701

is, the sum of video, social media, and public relations impressions, we find a short-run BCR of 13.110, and long-run BCR of 21.701. This means that the next dollar invested in any activity can be expected to produce $13.11 in net profit (present value) in the short run, and over $21.00 in the long run. The ROIs implied by these BCR estimates are 1,211% and 2,000%, 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 CTPB 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 3 show that social media impressions generate the highest BCRs of 12.981 (ROI = 1,198%) in the short-run, and 21.484 (ROI = 2,048%) in the long-run. In other words, funds invested in social media generate nearly $13 of incremental value (present value of profit) for every dollar invested in the short-run, and over $21 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 producers are presumably invested for the long-run, for practical purposes the long-run estimate is more meaningful, and suggests that investments in social media are highly profitable.

Returns to each of the other activities show a similar pattern, albeit slightly lower than either the aggregate or social media estimates. Public relations activities (BCR = 9.557, ROI = 855.7%) and video investments (BCR = 4.797, ROI = 379.7%) 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 public relations messaging among all CTPB 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 social media-related investments is 13.0, for example, and the marginal BCR in video is 5.0, then moving one dollar from video to social media "costs" only $5.00, but produces a return of $13.00. Therefore, there is an $8.00 gain in moving investments from video to social media. Because there are diminishing marginal returns to each activity, the act of moving funds from video to social media will result in the marginal return to social media to fall, and the return to video to rise, until the two are equalized at the optimal allocation. While determining that exact allocation is beyond the scope of this analysis, the recommendations are clear. That is, grower value is increased by reallocating budget from video and public relations toward 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 social media. 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 CTPB evaluations, but in optimizing both advertising expenditures, and pricing levels. Although our alternative data source for this analysis does not involve this type of point-of-sale data, it is useful in corroborating our NCTA-data results.

Qualtrics Experiment Data

In this section, we summarize the data obtained from our Qualtrics survey, and the econometric estimates obtained by applying a similar model that we used to analyze the NCTA data. For this analysis, however, the survey was cross-sectional in nature, so we do not evaluate CTPB programming using annual-variation in investment amounts as we did before. Instead, we include three "treatments" in a choice-experiment framework in order to determine the relative effectiveness of the 2017 "Farmers" campaign, the 2018 "Families" campaign, and the base CTPB "Keep it Real" logo. Consistent with our experimental method, we divide the sample into

four groups (N = 500 each) and expose equal-sized groups to either one of these advertising treatments, or a control treatment that see nothing at all. All groups choose experiment options that include the other experimental attributes, including price, point-of-sale, tree-height, and whether the tree was real or artificial.

We summarize the Qualtrics data in table 4 below. Based on this data, we see that the Qualtrics sample averages roughly 44 years of age, some college, over $73,000 per year in income, and approximates the national average in terms of percent White, and urban and suburban. However, it is of greater interest to examine how these consumer-attributes break down according to Christmas-tree preferences.

Table 4: *Qualtrics Data Summary*

Variable	Units	Mean	Std. Dev.
Age	Years	44.43	16.94
HH Size	Number	2.76	1.43
Education	Years	14.57	2.29
Income	$,000	73.63	60.60
White	%	68.52	46.45
Black	%	11.63	32.06
Hispanic	%	10.05	30.07
Asian	%	7.93	27.03
Urban	%	30.49	46.05
Suburban	%	48.77	50.00
Rural	%	20.20	40.16

In table 5, we disaggregate the demographic and socio-economic data in table 4 according to whether survey respondents report "usually" displaying a real or an artificial Christmas tree. We also test for statistical differences between the attributes of each market segment (if two means are not statistically different, it means that any observed difference is due to random variation and, in a larger sample, the two averages are actually the same). From the data reported in table 5, we see that real Christmas tree buyers are significantly younger than those who buy artificial trees, have larger households (in terms of numbers of people), and are more highly educated. This last effect, though, is relatively small. We also find that real Christmas tree buyers earn relatively more income, but do not differ significantly by race. They are, however, slightly more likely to live in areas that are either urban or rural, relative to artificial Christmas-tree buyers (although both are heavily suburban). These data draw a profile of a real Christmas-tree-buying household as a well-educated, high-income, younger family with children, that tends to live in the suburbs, but is more likely to be urban than an artificial-tree buyer. Although this may not be the demographic typically associated with buying trees (urban consumers tend to have less spacious homes), it is very attractive from a marketing perspective as they tend to have relatively high spending power, are are likely to be trend-setters and thought-leaders in terms of how the holidays are celebrated.

We next use these data to examine survey respondents' preferences regarding tree attributes. We show the results from this section of the survey in table 6 below. In this table, we ask subjects to rank 10 different tree attributes in terms of their relative importance. This method is valuable, because it does not rely on some arbitrary means of evaluating tree "quality." Rather, by asking subjects what they think important in shopping for a Christmas tree, relative to all other factors, we create a ranking index that is more likely to represent the true relative importance of each attribute.

We include price, height, type of tree, and various appearance attributes as a means of putting together as comprehensive a list of attributes as possible. According to the data in this table, the Qualtrics subjects considered price to be the most important attribute, followed by height and appearance. There is then a large gap in the average-ranking values before the convenience of point-of-sale, and whether the tree is real or artificial. This latter point is of clear importance to the CTPB as it suggests that consumers rank appearance above the provenance of the tree itself. Although artificial trees have likely become more "realistic" in appearance over the years, this finding suggests that the CTPB may want to consider de-emphasizing appearance in future advertising and public relations campaigns, and perhaps focus on themes that embrace the imperfections of nature, and glorify the differences between unique real trees, and cookie-cutter artificial trees.

We also asked respondents to the survey to provide their own subjective assessments of three core components of the CTPB advertising strategy over the 2016 - 2019 advertising period. That is, we asked respondents three questions with respect to visual materials taken from the CTPB website, and which were featured prominently in recent years: How much they "liked" the ad material, whether they had seen it, and whether the ad would make them more likely to purchase a real Christmas tree. The visual materials consisted of the "Keep it Real" logo, banner materials from the 2017 "Farmers" campaign, and

Table 5: *Qualtrics Data by Tree Preference*

		Real		Artificial		
Variable	Units	Mean	Std. Dev.	Mean	Std. Dev.	t-ratio
Age	Years	42.86	16.48	45.57	17.18	-3.60
HH Size	Number	2.85	1.47	2.70	1.41	2.44
Education	Years	14.78	2.27	14.40	2.30	3.70
Income	$,000	77.59	61.89	70.73	59.49	2.50
White	%	67.56	46.84	69.22	46.18	-0.79
Black	%	10.97	31.27	12.11	32.63	-0.79
Hispanic	%	10.85	31.12	9.46	29.28	1.02
Asian	%	9.22	28.95	6.99	25.51	1.80
Urban	%	33.37	47.18	28.39	45.11	2.39
Suburban	%	48.07	49.99	49.28	50.02	-0.53
Rural	%	18.09	38.51	21.74	41.26	-2.05

Table 6: *Attribute Rankings*

Attribute	Mean Rank	Std. Dev.
Price	3.43	2.39
Height	3.98	2.29
Appearance	4.21	2.35
Point of Sale	5.52	2.26
Real	5.61	3.60
Artificial	5.78	3.41
Storage	6.07	2.50
Wide	6.42	2.35
Needles	6.83	2.29
Slim	7.16	2.32

Table 7: *Qualtrics Ad Preferences*

	Units	Mean %	Std. Dev.
Like Logo	%	78.67	40.97
See Logo	%	18.08	38.49
Buy Logo	%	39.26	48.85
Like Farmer Ad	%	76.60	42.35
See Farmer Ad	%	18.57	38.90
Buy Farmer Ad	%	39.80	48.96
Like Family Ad	%	71.28	45.26
See Family Ad	%	19.31	39.48
Buy Family Ad	%	39.41	48.88

similar banner materials from the 2018 "Families" campaign. In each case, the responses ranged from "Strongly Agree" (response value = 1) to "Strongly Disagree" (response value = 5). For example, when presented with the "Keep it Real" logo, respondents were asked whether they "liked" the logo, and a response of "Strongly Agree" was coded with a value of 1, or "Strongly Disagree" was coded with a value of 5. For presentation purposes, we converted this response scale to percentages of respondents who indicated that they either "Strongly Agreed" or "Agreed" with the question at hand. Therefore, in table 7, more effective ads, or those that were liked, viewed, or were likely to be acted upon, code with higher percentage values.

The data in this table provide several important insights. First, each ad scores relatively high in an objective sense. That is, nearly 80% of respondents either "Strongly Agree" or "Agree" with the statement that they "like" the "Keep it Real" logo. The Farmer and Family ads score slightly lower with respect to the percentage who reported liking the ad, but all values are still above 70%. Second, very few report having seen the ads, substantially below 20% in each case. This should be of some concern to CTPB managers as visibility is clearly key to the marketing strategy. While achieving visibility is a matter for marketing strategists, it appears as though the current focus on public relations, video, and social media is not attracting consumer eyeballs, perhaps as intended. Third, each ad appears to have been successful in increasing purchase intentions, although they differ very little from each other in this regard. For each of the logo, Farmer, and Family materials, very close to 40% of respondents indicated that the material would cause them to be more likely to purchase a real Christmas tree as a result of seeing

the ad. This is perhaps the most important takeaway from this section of the survey. In summary, consumers would be more likely to purchase a real Christmas tree after seeing recent ad materials, but few are actually seeing them.

Returns to Marketing - Qualtrics

We conclude this section by presenting the results obtained by estimating an econometric model of Christmas-tree purchase tendencies using the Qualtrics choice-experiment data. While the econometric model is very much like the one applied to the NCTA data described above, the data differ in that subjects indicated which tree they preferred in 24 separate, hypothetical choice occasions, rather than reporting what they actually purchased. Because the objective of our experiment was to, most importantly, evaluate the effectiveness of CTPB marketing materials, we necessarily restricted our Qualtrics sample to Christmas tree buyers. Asking non-Christmas tree buyers to assess the relative importance of different tree attributes (e.g., price, real versus artificial, height, point-of-sale) in an experimental context is logically inconsistent, and would not produce meaningful results. With this in mind, however, our sample cannot be used to estimate the unconditional probability of purchasing a real Christmas tree, in a way that would be directly comparable to the NCTA purchase-probability estimate reported above (18.6%). In this sense, our experiment is not intended to duplicate the NCTA survey, but rather provide a more targeted approach to achieving the overall objective of this study, that is, estimating the return to CTPB marketing programs.

In the NCTA model above, we evaluated the historical impact of impressions classified as public relations, video, and social media. For the Qualtrics experiment, however, we defined three different campaigns, or specific ads, to serve as the basis for our experiment. In each case, the advertising elasticity of demand is calculated as the relative shift in demand induced by each particular ad, relative to the control case in which subjects saw no advertising material at all. The shift in demand is the increase in the probability of purchasing, relative to the control. We then calculate the change in aggregate demand implied by this elasticity, and calculate BCRs using the same approach as for the NCTA model above.

We begin our interpretation of the results with a comparison of the price-elasticity and advertising-elasticities of demand, and then move to the BCR results. Table 8 below presents our findings in terms of the elasticities implied by the econometric demand model, applied to the Qualtrics experimental data. Similar to the estimate from the NCTA-data model, demand for Christmas trees in the Qualtrics model is inelastic in the short run, and elastic in the long run. Relative to the previous model, however, demand is considerably more elastic. This outcome is to be expected because the Qualtrics experiment is conditional on Christmas tree buyers, and only examines their choices between real and artificial trees, plus a "none of the above" option. By allowing respondents to select nothing on each choice occasion, we permit their demand to be more elastic, which is much closer to reality.

Table 8: *Qualtrics Demand Estimates*

	Short Run	Long Run
Price	-0.901	-2.453
Logo	0.033	0.090
Farmers	0.024	0.066
Families	0.047	0.129

We also estimate the elasticity with respect to each ad with the Qualtrics data. Interpreting elasticities with respect to variables that are not continuous, such as the number of impressions in the NCTA-data model, is different, but directly analogous. Rather than representing the percentage change in demand for a given percentage change in the number of impressions, the elasticities here represent the percentage change in demand attributable to whether the ad is seen or not seen by the survey respondent. That is, if the ad is present, then demand increases by the percentage given by the elasticity value.

In table 8, we show that each ad generates a positive impact on the likelihood a respondent will purchase a real Christmas tree, relative to an artificial tree or nothing at all. [4] With respect to the base "Keep it Real" logo, for example, when a subject sees the logo, he or she is 3.3% more likely to purchase a real Christmas tree in the short run, and 9.0% more likely in the long run. The "Farmers" campaign material in 2017 is only slightly less effective, with a short-run elasticity of 2.4% in the long run, and 6.6% in the long run. Finally, the "Families" campaign in 2018 appears to be the most effective of all three ads, generating a response elasticity of 4.7% in the short run, and 12.9% in the long run. A positive elasticity,

[4] We do not report statistical significance in the table, for clarity, but each elasticity estimate is significantly different from zero at a 5% level of significance.

however, does not guarantee a strong rate of return.

Table 9: *Qualtrics Model BCRs*

	Short Run	Long Run
Base Logo	23.402	32.575
Farmers	17.001	23.664
Families	33.467	46.585

In table 9, we show the BCRs associated with each of the three ad-banners shown to respondents in the experiment. Unlike in the previous case, however, we had exact estimates of the amount spent in each area. For purposes of this table, we assumed that each can be classified as "public relations" expenditure, and attributed the average annual public relations spending to the development of these ad campaigns (roughly $63,500). To the extent that these campaigns only represented a part of total PR spending, our estimates will be conservative. However, the elasticity values in table 8 imply very strong BCR values, for each ad. Namely, the short-run return to the Base Logo is $23.4 for the next dollar invested, and $32.6 in the long run. Both of the other ad campaigns produced strong returns, with the "Farmers" campaign generating $17.0 in the short run, and $23.7 in the long run for the next dollar invested, while the "Families" campaign was the most profitable, producing $33.5 for the next dollar invested in the short run, and $46.6 in the long run. Clearly, although these ads were apparently not seen by all consumers, they still generate a sufficiently high return to warrant continued investment in similar messaging.

Conclusions and Recommendations

Purchases of real Christmas trees rose over the study period (2016 - 2019). This study uses survey data from 2017 - 2019, and new experimental data generated via an online choice experiment, to investigate the return on investment for grower-shipper dollars invested in all CTPB marketing activities, including public relations, video, and social media activities. Because many factors other than marketing activities can explain changes in demand over time, the specific role of the CTPB in helping maintain consumer demand is an important, and empirical question.

Using the NCTA survey data, we find that all CTPB activities were effective in raising demand when controlling for the effect of prices, tree attributes, consumer demographics, alternative tree prices, and other factors relevant to the demand for real Christmas trees. Among the types of activity reported in CTPB budget data, we find that social media investments were particularly profitable in the Christmas tree market, dominating the return to all CTPB marketing activities. Investments in video-related media were the least profitable, yet still provide 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 CTPB marketing activities.

With respect to the Qualtrics choice experiment data, we focused specifically on the return to developing the "Keep it Real" logo, the 2017 "Farmers" campaign material, and the 2018 "Families" campaign material. In each case, we found strong returns in both the short run, and long run. These estimates were obtained after controlling for a similar set of potentially-confounding factors as in the NCTA survey model above, and using a very similar econometric approach. In general, our Qualtrics experiment validates the results obtained with the NCTA data, and corroborates the strong returns found with the existing survey data.

In arriving at these conclusions, we recognize that the quality of our findings are inevitably limited by the quality of the data. 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. While we answer a different question with the Qualtrics survey data, the fact that they both provide similar estimates of the market-impact of CTPB activities serves to validate the existing NCTA survey. That said, we recommend that the CTPB 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 social media appear to be far more profitable than either investments in public relations or video. 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 CTPB could allocate more budget to social me-

dia, 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 CTPB marketing activities on the demand for US Christmas trees. 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 CTPB 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 CTPB 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 CTPB 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: $dlnQ_r = N_r dlnP + GdlnZ_r + B_1 dlnA_1 + B_2 dlnA_2$,
- Import Demand: $dlnQ_m = N_m dlnP + HdlnZ_m$,
- Farm Supply: $dlnX = E_s dlnW$,
- Price Transmission: $dlnW = TdlnP$,
- 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:

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

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;
- $M = E_sT - w_rN_r - w_xN_x$ = 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 CTPB. If NPV_l is greater than zero at an interest rate that reflects CTPB 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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