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**Quantitative Analysis and  
Assessment of the Effectiveness of  
Marketing and Promotion Activities  
for the U.S. Pecan Industry**

FORECASTING AND BUSINESS ANALYTICS, LLC

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## **A QUANTITATIVE ANALYSIS AND ASSESSMENT OF THE EFFECTIVENESS OF MARKETING AND PROMOTION ACTIVITIES FOR THE U.S. PECAN INDUSTRY**

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### **ABSTRACT**

Based on state-of-the-art econometric analysis and simulation, pecan marketing and promotion activities made by the APC and the APPB over the period 2020/21 to 2023/24 can take credit for enhancing domestic utilization by 3.2%, weighted average grower prices by 13.2%, export prices by 9%, export revenue by 8.1%, and producer profit by \$282.5 million by 13.7% (not accounting for the cost of the assessments). This increase in gross profits of close to \$300 million, which includes a \$202.2 million lift from domestic promotion and another \$80.3 million lift from export promotion, would not have been generated without the joint efforts of the APC and the APPB, a remarkable achievement with a modest budget over a short period of time.

Notably, the generic domestic and international marketing efforts associated with the pecan checkoff program over the period 2020/21 through 2023/24 generated a net return-on-investment (ROI) of roughly 14 to 1 for industry stakeholders who paid for the program. The ROI for the period 2016/17 through 2019/20 was calculated previously at nearly 10 to 1. Simply put, the ROI to marketing and promotion activities has been sustained since the initial study was conducted in January 2021. After accounting for the cost of the promotion programs--\$12.8 million for domestic promotion and \$5.9 million for export promotion, the net ROI for domestic promotion was calculated to be 14.8 to 1, while the net ROI associated with export promotion was calculated to be 12.6 to 1.

This analysis also demonstrates that the incremental revenues generated from the pecan checkoff program resulted in a modest contribution to the U.S. economy, namely \$544.4 million in additional national output or total spending as well as \$426.2 million in additional domestic GDP, created \$274.8 million in U.S. labor income, generated \$86.9 million in additional taxes (federal, state, and local), and added 849 part-time and full-time jobs.



## ACKNOWLEDGEMENTS

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## EXECUTIVE SUMMARY

The over-arching objective of this study, like the initial study completed in January 2021, is to measure and assess the economic effectiveness of generic marketing and promotion activities for the U.S. pecan industry. In this report, we measure the shift in demand for U.S. pecans because of marketing activities associated with domestic promotion and export promotion. Additionally, we measure the returns from the checkoff program to pecan industry stakeholders (those who pay for the marketing and promotion activities). Consistent with the requirements of the Request for Proposal (RFP), the broad objectives are to ascertain the effects of marketing and promotion activities on three key measures: (1) domestic demand for U.S. pecans; (2) export demand for U.S. pecans; and (3) the return-on- investment (ROI) to U.S. pecan industry stakeholders.

Unequivocally, rightward shifts in the domestic demand for pecans, the export demand for pecans, and the import demands of pecans from the United Kingdom, China, the Netherlands, and India were evident because of the checkoff program. A principal accomplishment of the domestic and export marketing and promotion activities has been to support the annual average producer price of pecans about 23¢ per pound (13%) above the level it would have been had these efforts not been made over the period of 2020/21 through 2023/24. Thus, with higher prices than would have occurred without the promotion on about the same level of production, pecan producer profit was also higher than it might otherwise have been without the promotion by a total of about \$282.5 million (14%) over the study period.

Domestic and export promotion of pecans provided a lift to pecan producer profit over the period of 2020/21 to 2023/24 by \$282.5 million (13.7%), including a \$202.2 million lift from domestic promotion and another \$80.3 million from export promotion. After accounting for the cost of the promotion programs--\$12.8 million for domestic promotion and \$5.9 million for export promotion, the net BCR for domestic promotion was calculated to be 14.8 to 1, while the net BCR associated with export promotion was calculated to be 12.6 to 1. Given that promotion expenditures over the study period totaled \$18.7 million, the BCR to the overall pecan promotion expenditures over the study period was calculated to be 14.1. The primary conclusion from this analysis is that the generic domestic and international marketing efforts associated with the pecan checkoff program over the period 2020/21 through 2023/24 generated a ROI on the order



of 14 to 1 to industry stakeholders who paid for the program. In the previous report, the ROI for the period 2016/17 through 2019/20 was calculated at nearly 10 to 1. Simply put, the ROI to marketing and promotion activities has been sustained since the initial study was conducted in January 2021.

Of note, this analysis also demonstrates that pecan checkoff program revenues have made a modest contribution to the U.S. economy. With the disbursement of \$18.7 million on domestic and export promotion, the cumulative net revenue to pecan growers was \$263.76 million, after netting out the cost of the promotion programs (\$81.35 million for 2020/21, \$81.82 million for 2021/22, \$57.04 million for 2022/23, and \$43.55 million for 2023/24). In turn, this incremental net revenue based on input-output analysis (IMPLAN analysis) led to spillovers or multiplier effects for the general economy. The total of all the direct, indirect, and induced effects of the \$263.76 million of U.S. pecan checkoff program incremental revenues for the period 2020/21 to 2023/24 on total spending in the U.S. economy amounted to \$544.4 million. That is, the \$263.76 million of producer revenues stimulated U.S. economic activity that generated \$544.4 million in total spending. At the same time, the economic activity stimulated by those incremental net producer revenues added \$426.2 million to domestic GDP, created \$274.8 million in U.S. labor income, generated \$86.9 million in taxes (federal, state, and local) and added 849 part-time and full-time jobs.

This analysis and assessment leads to several important implications for management. First, the magnitude of the BCR or ROI for pecan promotion expenditures (14.1 to 1) calculated in this study is greater than the BCRs calculated for programs like soybeans, cotton, beef, and pork. This relatively high BCR primarily reflects the smaller size of pecan promotion expenditures compared to those of other major commodities, many of which spend more than \$100 million per year on promotion. Not only is the average amount spent each year since its inception in 2016/17 quite small in comparison to that spent each year of larger generic agricultural checkoff programs, the pecan promotion intensity, that is, the ratio of pecan promotion expenditures to the value of pecan production, was only 0.2% on average over the 2020/21 to 2023/24 period, compared to generally about 2% for the larger programs. In other words, stakeholders in the larger generic commodity promotion programs pay more and contribute a generally higher share of their industry revenues to their respective commodity promotion programs than do pecan growers, shellers, and importers.

Second, a key implication that follows from the previous point is that the marketing and promotion program for pecans is likely underfunded, which imposes a notable opportunity cost on pecan producers of potentially millions of dollars. For every dollar in additional assessment NOT paid by pecan producers and, thus, not spent on pecan promotion, producers lose on average \$14.1 in additional profit. Of course, increases in assessment rates and total spending on promotion are usually accompanied by a reduction in the corresponding BCR. But with a BCR of this magnitude, producers could profitably afford to increase the assessment rate substantially beyond current levels and still expect to generate a very reasonable rate of return comparable to the \$2 to \$6 per dollar of promotion earned by industry stakeholders associated with beef, pork, cotton, and soybeans.

Third, the sizable BCR calculated for the pecan promotion program is not indicative of the level of impact of the program on the U.S. pecan industry. The BCR indicates only the return generated from the investment and not the level of impact that promotion had on pecan production, utilization, exports, price, or producer revenue. Because the BCR as a measure of effectiveness is



often misunderstood, perhaps the best metrics of effectiveness are the impacts of domestic and export promotion on key industry measures. In the case of pecans, we determine through sophisticated econometric analysis and simulation that pecan promotion expenditures can take credit for supporting domestic utilization by 3.2%, weighted average grower prices of pecans by 13.2%, export prices by 9%, export revenue by 8.1%, and enhancing producer profit by \$282.4 million (not accounting for the cost of the assessments to producers) (13.7%). This gain in profits of close to \$300 million would not have been earned by producers without the efforts in promotion, a remarkable achievement with a modest budget over a short period of time from 2020/21 to 2023/24.



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# A QUANTITATIVE ANALYSIS AND ASSESSMENT OF THE EFFECTIVENESS OF MARKETING AND PROMOTION ACTIVITIES FOR THE US PECAN INDUSTRY

## Background

Established in November 2016 by Federal Marketing Order (FMO) 986 of the Agricultural Marketing Service (AMS, USDA), the American Pecan Council (APC) represents grower and sheller members from 15 states (Alabama, Arkansas, Arizona, California, Florida, Georgia, Kansas, Louisiana, Missouri, Mississippi, North Carolina, New Mexico, Oklahoma, South Carolina, and Texas). FMO 986 went into effect on August 2, 2016. The marketing order authorizes data collection, research and promotion activities, and regulation of grade, size, quality, pack and containers for pecans<sup>1</sup>. The purpose of FMO 986 is to assist the American pecan industry with the promotion, research, standardization, and consumer education of American pecans. The FMO provides the pecan industry with a coordinated program designed to strengthen the American pecan industry's position in the marketplace, with a particular focus on increasing U.S. exports of pecans.

The American Pecan Promotion Board (APPB) was established in 2021 under the auspices of the Pecan, Promotion, Research, and Information Order. The pecan research and promotion program now operates under the direction of the APPB. The mission of the APPB is to strengthen the position of pecans in the marketplace, maintain and expand markets for pecans, and develop new uses for pecans. The program is financed by assessments on domestic producers and importers of pecans. The APPB supports nutritional and agricultural research studies to expand knowledge about the nutritional benefits of pecans and improve production practices across the industry.

Under the FMO, administered by the APC, various activities are paid for by assessments on the volume of pecans purchased from growers by first handlers. The APC assessment rate for improved pecans was set originally at \$0.03 per pound, but at present the assessment rate has been reduced to \$0.01 per pound. The rate for native/seedling pecans was reduced from its initial level of \$0.02 per pound to zero. The APPB assessment rates are \$0.02 per pound (in-shell) and \$0.04 per pound (shelled) for promotion and research. These rates apply to producers and importers who handle an average of 50,000 pounds or more of in-shell pecans (or 25,000 pounds of shelled pecans) over four fiscal periods. These assessments are separate fees paid by handlers and importers to fund marketing, research, and industry programs.

The APPB was created in October 2021, but because of the time needed to form its inner working circle and to begin collecting assessments, promotional efforts did not start until Fall of 2022. From Fall 2022 to Fall 2023, there was some overlap between APC and APPB marketing and promotion activities. The shift to APC focusing on industry and international markets and to APPB focusing on the domestic market and Mexico as well as nutrition research did not fully operationalize until Fall 2023. As such, in this report, we place emphasis on **domestic promotion and export promotion** activities of pecans rather than APC activities vs APPB activities.

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<sup>1</sup> <https://www.ams.usda.gov/rules-regulations/moa/986-pecans>



Title V of the 1996 Farm Bill<sup>2</sup> requires an independent evaluation of the effectiveness of all new and existing generic commodity promotion programs, not less than every five years, to assist Congress and the Secretary of Agriculture in ensuring that the objectives of the programs are met. In compliance with that legislation, the APC commissioned the initial study of its advertising and promotion activities which covered the period of 2016/17 through 2019/20. This study constitutes **the second evaluation** mandated by Congress covering the period 2020/21 to 2023/24.

### Objectives and Scope

The over-arching objective of this study, like the initial study completed in January 2021, is to measure and assess the economic effectiveness of generic marketing and promotion activities for the U.S. pecan industry. In this report, we measure the shift in demand for U.S. pecans because of marketing activities associated with domestic promotion and export promotion. Additionally, we measure the returns from the checkoff program to pecan industry stakeholders (those who pay for the marketing and promotion activities). Consistent with the requirements of the Request for Proposal (RFP), the broad objectives are to ascertain the effects of marketing and promotion activities on three key measures: (1) domestic demand for U.S. pecans; (2) export demand for U.S. pecans; and (3) the return-on- investment (ROI) to U.S. pecan growers, shellers, importers.

In addressing these objectives, we specifically measure the impacts of the checkoff program on (1) improved pecan production (in-shell); (2) native pecan production (in shell); (3) total pecan production (in-shell); (4) total pecan production (shelled); (5) pecan import supply; (6) domestic pecan utilization; (7) ending stocks; (8) export demand; (9) price of improved pecans (in-shell); (10) price of native pecans (in-shell); (11) weighted average producer price of pecans (in-shell and shelled); (12) import price of pecans; and (13) export price of pecans. We acknowledge that the fiscal year begins October 1 in the previous year and ends September 30 in the subsequent year. The impacts of and return on investment to the respective marketing and promotion activities are measured over the period from 2020/21 to 2023/24. We subsequently compare the results over the period from 2020/21 to 2023/24 to those over the period 2016/17 to 2019/20.

### Methodology

The methodology involves four steps: (1) econometric analysis of domestic demand and export demand; (2) use of PecanMod to conduct simulated impacts on the U.S. pecan industry attributed to the checkoff program; (3) benefit-cost analysis associated with domestic promotion, export promotion, and combined (domestic and foreign market) promotion efforts; and (4) use of IMPLAN to determine employment, labor income, value-added, output, and tax contributions to the general economy facilitated by the incremental revenue to growers, shellers, and importers generated by the checkoff program.

#### *Econometric Analysis*

Initially, the relationship between pecan promotion expenditures and the domestic and export demands for U.S. pecans is statistically analyzed using applied econometric procedures to answer two key questions: (1) What have been the effects of domestic promotion and foreign market promotion program? and (2) Have those marketing expenditures benefited pecan growers and shellers who pay the assessments used to promote pecans? We use state-of-the-art econometric

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<sup>2</sup> Federal Agriculture Improvement and Reform (FAIR) Act of 1996, PL 104-727, 7 U.S.C. 7201 *et seq.*



procedures to measure the U.S. pecan market and price effects of the various marketing and promotion activities. Simply put, the econometric analysis focuses on the relationship between marketing/promotion expenditures and the U.S. domestic and export demands for pecans over the period 1980/81 through 2023/24.

The econometric analysis is designed to determine whether marketing/promotion expenditures have effectively shifted out the domestic and export demand for U.S. pecans. If the answer to that question is “yes,” then the next question is whether these rightward shifts in domestic and export demand for pecans achieved over time has benefitted stakeholders (those who have contributed to the program). Obviously, if the answer to the first question is “no,” then the answer to the second question is “no” as well. However, if the answer to the first question is “yes,” the answer to the second question is not necessarily “yes” because any consequent increase in revenues to the stakeholders may or may not be sufficient to cover the cost of the programmatic activities. Simply put, this analysis involves the econometric evaluation of the impacts of the demand-enhancing marketing and promotion activities on domestic demand and export demand of pecans, ultimately leading to the calculation of the return-on-investment (ROI) to industry stakeholders.

#### *PecanMod--Simulation Model of the U.S. Pecan Industry*

The results of the respective econometric analyses are subsequently incorporated into PecanMod, a simulation model of the U.S. pecan industry (Capps and Williams, 2019; and Capps and Williams, 2021), to measure the broader effects of marketing/promotion expenditures on U.S. pecan production, consumption, inventory, trade, and prices. With PecanMod, we analyze two simulation scenarios: (1) a “With Expenditures” scenario in which demand-enhancing marketing and promotion expenditures are set to their actual historical levels and (2) a “Without Expenditures” scenario in which checkoff expenditures are set to zero over the history of the program.

We implement PecanMod to generate a baseline historical simulation of (1) improved pecan production (in-shell); (2) native pecan production (in shell); (3) total pecan production (in-shell); (4) total pecan production (shelled); (5) pecan import supply; (6) domestic pecan utilization; (7) ending stocks; (8) export demand; (9) price of improved pecans (in-shell); (10) price of native pecans (in-shell); (11) producer price of pecans (shelled); (12) import price of pecans; and (13) export price of pecans over the period 1980/81 to 2023/24. Differences in the solution values of the endogenous variables in the “Without Expenditure” scenario from their baseline solution values in the “With Scenario” consequently are direct measures of the effects of the marketing and promotion activities. Because no other exogenous or predetermined variables in PecanMod are allowed to change (e.g. real disposable income, exchange rates, and tariffs, etc.), this process effectively isolates the impacts of the marketing/promotion expenditures associated with the checkoff program for pecans on the respective variables mentioned previously.

#### *Benefit-Cost Analysis or Return-on-Investment Analysis*

Once the market effects are determined, we are positioned to conduct a benefit-cost analysis or return-on-investment (ROI) analysis of pecan promotion expenditures to determine the return to growers, shellers, and importers. In the analysis, the pecan producer benefit-cost ratio (BCR) is calculated as ratio of the additional producer net revenue (profit) generated by domestic



promotion, export promotion, and combined promotion over the period 2020/21 to 2023/24 and the cost of the promotion over that period.

### *IMPLAN—Contributions of the Pecan Checkoff Program to the U.S. Economy*

Using the incremental revenues generated from PecanMod because of the respective marketing and promotion activities, we conduct a contribution analysis to the U.S. economy using IMPLAN (IMPact analysis for PLANning) input-output system (IMPLAN Model, 2022). Input-output analysis is based on the idea that a change in one sector of the economy (tree nuts, specifically pecans) affects other sectors (the multiplier effect).

The economic effects that are reported from the IMPLAN analysis include the contributions due to employment, labor income, value-added, output, and taxes. The employment contribution measures the number of jobs (both full-time and part-time) attributable to direct economic activity stimulated because of the checkoff program. The labor income contribution measures the effect of spending by businesses on the incomes of households. The value-added contribution measures the return to resources used by businesses. The output contribution measures economic activity (total spending) generated. The tax contribution is measured by the direct tax contributions by businesses and their employees as well as by the indirect tax revenue generated through the supply chain and household spending.

## **MARKETING AND PROMOTION EXPENDITURES FOR U.S. PECANS OVER THE PERIOD 2020/21 TO 2023/24**

To measure the impact of marketing and promotion activities on domestic demand and export demand, we rely on expenditures made by the APC and the APPB. This information was provided by Brandon Drummond, Director of Finance. We report the monthly nominal (no adjustment for inflation) marketing and promotion expenditures from October 2020 to September 2024. We also report monthly expenses for general administration and total expenses over this period. Further, we decompose marketing and promotion expenses into domestic demand-enhancing program expenses<sup>3</sup> and international demand-enhancing program expenses.

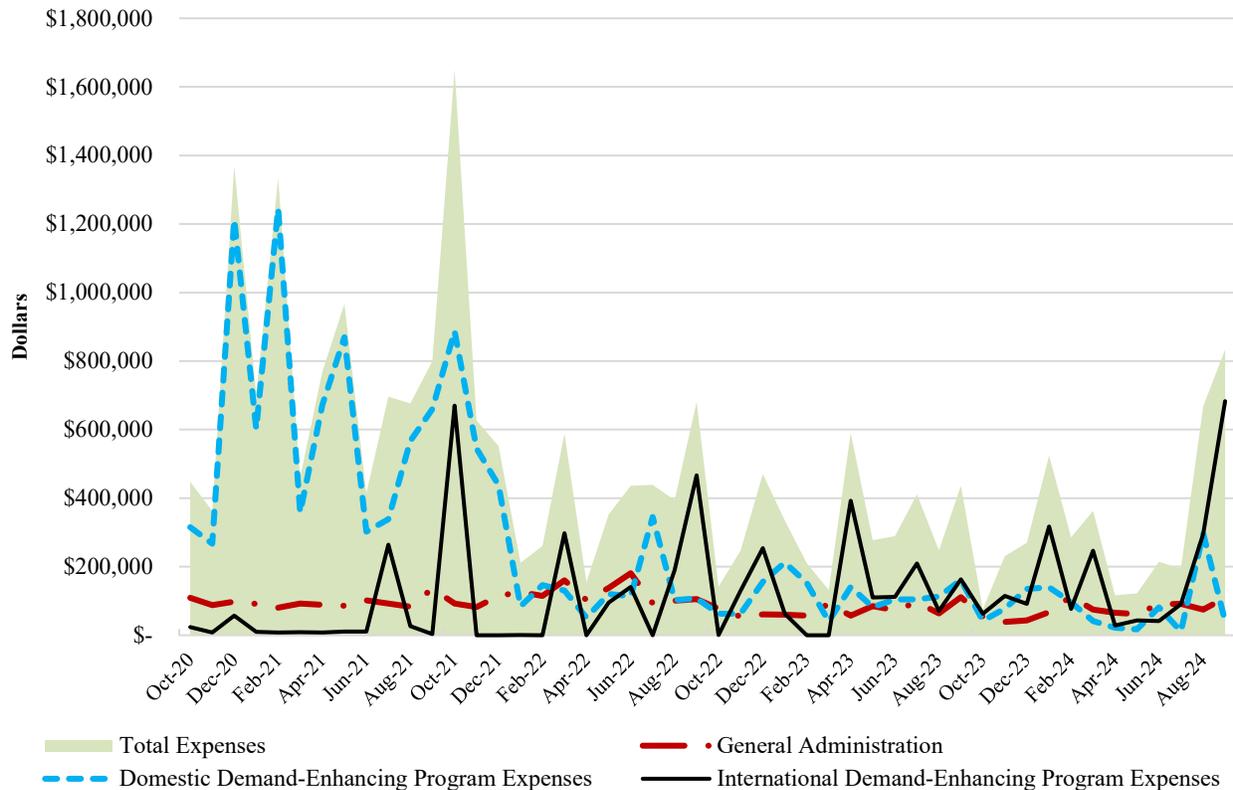
The nominal marketing and promotion expenditures for U.S. pecans by category over the 2020/21 to 2023/24 is exhibited in Figure 1. Total expenses cumulatively amounted to \$23.033 million from October 2020 to September 2024. The share of total expenses for the general administrative category was 18.83% on average over this period. The share of total expenses for domestic demand-enhancing market and promotion activities was 55.55% on average, and the share of total expenses for international demand-enhancing programs was 25.62% on average. Cumulatively, domestic marketing and promotion expenditures outnumbered international marketing and promotion expenditures by a ratio of 2.17 to 1 over the period 2020/21 to 2023/24.

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<sup>3</sup> To be consistent with the initial evaluation, domestic demand-enhancing expenditures are those related to grades & standards, industry relations, domestic marketing, and research.



**Figure 1: Marketing and Promotion Expenditures for U.S. Pecans by Category, 2020/21-2023/24**



Source: Created by authors based on the data provided by Brandon Drummond, Director Finance (2025).

## THE ECONOMICS OF GENERIC DEMAND PROMOTION

The primary objective of any generic commodity promotion program is to foster the growth and profitability of the production of that commodity. Ultimately, individual growers, shellers, and importers contributing to the program expect that the funds will be spent in such a way so that they will be individually better off than they would have been without the promotion program. What can reasonably be expected of a generic demand promotion program in terms of the market effects and the effects on producers or stakeholders? This section explores various aspects of the economics of generic commodity promotion as background to the subsequent analysis of the marketing and promotion activities for U.S. pecans.

### The Market Effects of Generic Demand Promotion

The principal objective of marketing and promotional activities is to induce a rightward shift in demand and, thereby, increase the market price on a higher volume of sales over time. Several important issues, however, have influenced the effectiveness of promotion in boosting the level of U.S. consumption and exports of U.S. produced pecans. The most important of these issues include: (1) the limited ability of domestic supplies of U.S. pecans to increase in response to any promotion-induced price in the short-run; (2) the availability of pecan supplies from imports; (3)



the conflict from promoting domestic demand and export demand for pecans simultaneously; (4) well-documented characteristics of the response of sales to advertising and promotion programs, and (5) the general effectiveness of generic commodity promotion programs.

### U.S Pecan Supply Response to Marketing and Promotion

Indeed, marketing and promotion programs that successfully shift out the demand curve, or in non-economic parlance, “move the needle,” raise market prices. In raising prices, however, promotion programs also stimulate a greater level of production than would have occurred, which in turn moderates the extent of the price increase. That said, the supply of pecans available from U.S. growers should be relatively unresponsive to prices in the *short run* because of the length of time required for U.S. pecan production to respond to changing prices.

Pecan trees take from 6 to 10 years to start producing nuts and do not reach full production until around 12 to 15 years. Thus, any price increase that occurs in the pecan market from promotion efforts will have little effect on production for several years. Some response of U.S. native/seedling pecan production could occur over a shorter period particularly as growers harvest more of their pecans as prices increase. However, native/seedling pecans make up a small percentage of total U.S. pecan production, generally accounting for roughly three to five percent of the total annual crop in recent years. Consequently, a *noteworthy* response of U.S. pecan supply to a promotion-induced pecan price increase is not likely in the short run. Thus, if marketing and promotion activities stimulate either the domestic demand and/or the export demand for pecans, the main result would be higher prices on essentially the same supply of U.S. pecans.

#### *The Availability of the Pecans Supplies from Imports*

In the short run, U.S. pecan producers face the temporal problem wherein few additional U.S. supplies of pecans can be made available for a notable number of years following increases in demand from marketing and promotion activities. Almost all increases in sales volume over the short run would be attributed to increased supplies from Mexico and/or reductions of U.S. pecan exports.

Even though the U.S. pecan supply cannot change much in response to a price increase from promotion in the short run, supplies of imported pecans can be more price responsive to some extent because Mexico or other pecan exporters can divert some of their pecan exports to higher-priced U.S. markets. Thus, the volume of U.S. utilization would increase to some extent depending on how responsive imports are to price changes. However, the increase in the volume of utilization would come predominantly from imports. Further, the price effect would be muted to some extent due to the larger supplies of pecans from imports.

If U.S. producers are patient in continuing to promote pecan consumption, then over time, U.S. pecan trees previously planted due to the promotion-induced increase in U.S. prices will begin to yield additional pecans so that more of the additional U.S. sales due to the promotion will begin to be U.S. pecans and less from imports. As long as producer profit generated by the demand promotion is greater than the cost of the promotion, growers gain from the promotion. The amount of the gain depends on multiple factors including how effectively pecans are promoted, how much is spent on promotion, and how price responsive demand, production, and import supplies are to any price increase prompted by pecan promotion.



### **The Conflict from Simultaneously Promoting Domestic and Export Demand for Pecans**

To stakeholders in the pecan industry, demand is demand, no matter whether foreign or domestic consumers purchase pecans. Increases in demand increase price, no matter whether foreign demand or domestic demand. However, what happens to U.S. domestic and export sales of pecans depends on whether the promotion is done domestically or internationally. With greater domestic demand, we would expect a rise in price, a higher level of domestic use, and a lower level of exports. With greater export demand, the consequence is, again, a rise in the price of pecans, but this time accompanied by a greater level of exports. The domestic use of pecans would be expected to decline due to the greater volume of available U.S. pecan supplies going to export markets. Domestic demand promotion would be expected to result in lower exports and higher domestic use whereas export demand promotion would be expected to result in lower domestic use but higher levels of exports. Unequivocally, domestic demand promotion and export demand promotion raise the market price.

A key question to address is whether the effectiveness of marketing and promotion is greater for export markets compared to the domestic market or vice versa. Over the period 2020/21 to 2023/24, the amount spent on domestic marketing and promotional activities for pecans has been more than twice the amount spent on export marketing and promotional activities. The answer to the question concerning effectiveness of marketing and promotion rests on the estimation of the elasticities or sensitivities of promotion expenditures associated with domestic demand and export demand. Whether promotion leads to rightward shifts in domestic demand by relatively more or less than in export demand, pecan prices undoubtedly will increase.

### **The Relationship between Checkoff Spending and Demand Promotion**

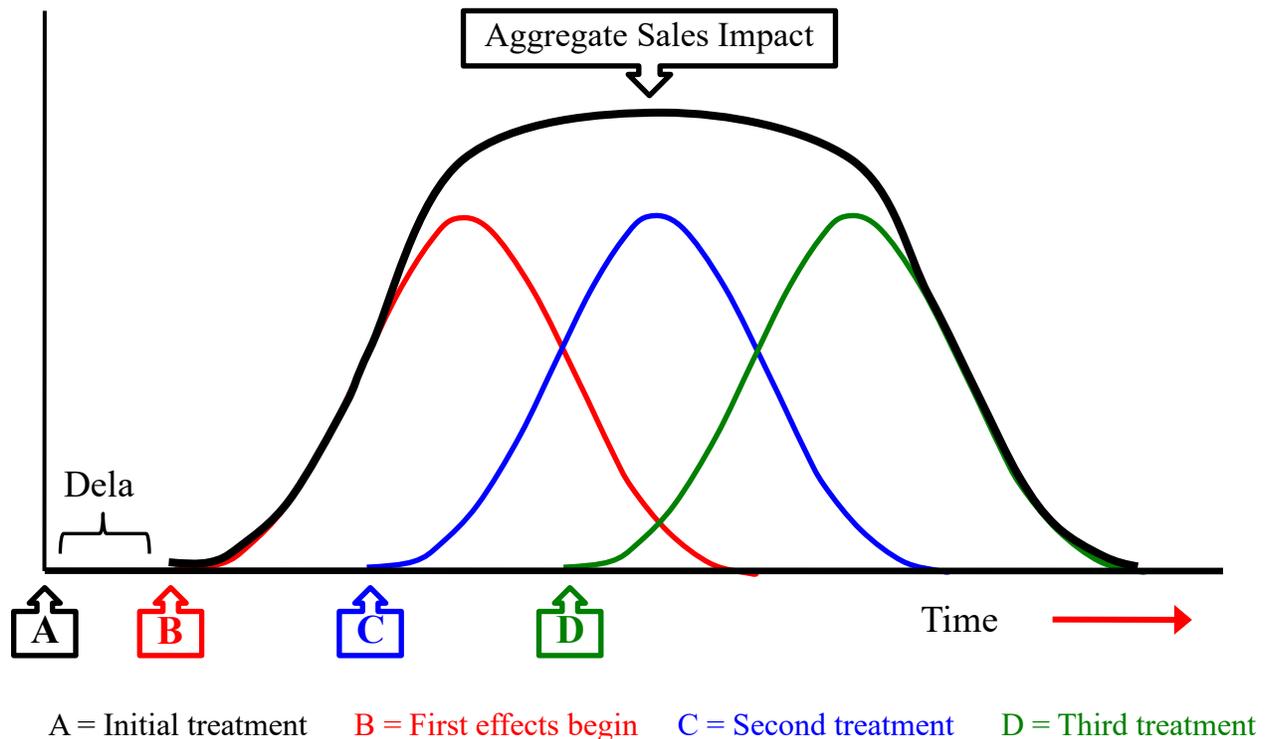
In addition to the various complications of U.S. and import supply response to promotion and the conflicts from promoting both domestic and export demand at the same time, the linkage between investments in demand promotion of any type and the anticipated market effects is further complicated by a number of well documented characteristics of the response of sales to advertising and promotion programs, including: (1) the magnitude of the sales response to promotion, (2) the minimum promotion threshold, (3) the delay effects of promotion, (4) the lagged or carryover effects of promotion, (5) the decay of promotion effects, and (6) advertising and promotion ‘wearout’.

Evidence from prior research suggests that the *response of sales to advertising* is positive and statistically significant but relatively small in magnitude or elasticity (Ward, 2006). Also, prior research has demonstrated that some *minimum level of promotion expenditures* and messages are typically required to begin having any effect. Below that level, promotion expenditures may be simply unable to generate sufficient recall or awareness to motivate consumers, either domestic or international.

Even if investments in promotional activities are well above the minimum threshold level, there may be a *delay effect of promotion*, that is, a delay between the time that the investment is made, and the market impact of the investment is expected depending on the type and objective of the promotion program.



**Figure 2: Delay, Carryover, and Decay Effects of Demand Promotion**



Promotion expenditures also tend to have *lagged or carryover effects*. Expenditures made over a given period often do not have their full impact within that period but continue to impact sales over extended periods of time. Generic promotion activities, like those generally funded by checkoff programs in both domestic and foreign markets, are generally directed toward longer-term responses and, therefore, have often been found to generate lengthy lagged or carryover effects (Forker and Ward, 1993). Promotional activities also often display *decay effects* over time. That is, despite the carryover effects, marketing and promotional activities will not last forever and eventually will begin to fade at some point.

*Advertising 'wearout'* is also a consideration. Even though the continual exposure of any advertising message to consumers can help stem the decay effects of promotion expenditures, after long periods of exposure to a particular message, additional promotion expenditures on that message generally will have decreasing impacts on sales.

We illustrate a typical pattern of promotion effects on sales in Figure 2. Following the initial treatment (expenditure) at point A, there is usually some delay before the expenditure begins to impact sales at point B, assuming that the promotion expenditures are above some threshold level. The maximum impact of the initial treatment in Figure 2 is eventually reached after which there is some decay in the sales effects.



Continued promotion treatments (expenditures) (points C and D) can maintain the aggregate level of sales achieved with the first two treatments (dark black line in Figure 2). If promotion activities are ended altogether, the level of sales will taper off toward the pre-promotion program level over time. Research suggests, however, that because promotion programs may achieve some permanent change in user behavior, sales will not drop all the way back to pre-program levels after a promotion campaign. Forker and Ward (1993) note that without the decay phenomenon, there would be no reason for continued expenditures on promotion activities after the initial effort.

### Overview of Research on the Effectiveness of Commodity Checkoff Programs

Early evaluation of the effectiveness of and producer returns from commodity checkoff programs relied largely on anecdotal evidence and simple comparisons of gross promotion expenditures against changes in prices, profitability, and utilization of the commodities being promoted. When commodity markets and producer profits as well as checkoff program expenditures are all growing, this approach to evaluation can yield a persuasive upward-sloping graphical relationship between promotion expenditures and market prices, demand, and profits.

The problem with this comparison-of-checkoff-expenditures-to-market-variables approach to evaluating a checkoff program is that many factors other than checkoff expenditures affect the markets for agricultural commodities, many of which have considerably greater influence on commodity markets than checkoff programs. Market events like changes in the costs of production inputs, weather (e.g., hurricanes), imposition of tariffs, currency exchange rate fluctuations, changes in the performance of U.S. and foreign macroeconomies, changes in consumer buying habits, changes in government policies, and global events like the COVID-19 pandemic, to name just a few, can move markets up or down over a given time period despite what checkoff programs may be doing to influence markets. This problem becomes rather apparent when commodity markets experience downturns despite continued expenditures by the related checkoff programs. If checkoff programs take credit for increased producer prices and profits when checkoff expenditures and markets are growing, then they are usually forced to take the blame for failing to prevent a reduction in producer prices and profits when markets decline. The need to isolate and measure the unique contribution of commodity checkoff programs to the performance and profitability of the related commodity markets has led researchers to devise improved means of evaluating the effectiveness and stakeholder returns from those checkoff programs.

A standard method of determining if advertising and promotion is economically feasible has been to calculate a benefit-cost ratio (BCR) which corresponds to the *average* return to producers who pay for the promotion per dollar spent on advertising and promotion. A BCR calculated as the *market sales revenue or cash receipts* (net of promotion costs) received by producers per promotion dollar spent on advertising and promotion is referred to as a *revenue BCR* (RBCR).

When any additional production costs are first netted out of the additional producer revenue calculated to be generated by the program, the resulting BCR can be referred to as a *profit BCR* (PBCR). Sometimes researchers use an economic measure of the increase in producer economic welfare (referred to as producer surplus) generated by a promotion program instead of revenue or profit to calculate a *surplus BCR* (SBCR). A profit and a surplus BCR should provide roughly equivalent measures of the return to producers from investments in demand promotion. To account



for the time value of money, researchers often discount the calculated BCR for a promotion program to present value by first discounting the calculated returns to stakeholders over time before dividing by total advertising and promotion expenditures to generate a *discounted BCR* (DBCR).

Regardless of the method of calculation, a BCR of greater than 1 is indicative that the program is beneficial because sales, profits, or economic surplus have increased by more than one dollar for every dollar spent on advertising and promotion. On the other hand, a BCR of less than 1 means that advertising and promotion do not pay since each dollar spent generates less than a dollar in additional sales, profits, or economic surplus.

In most studies of commodity checkoff programs, advertising and promotion increase the return to producers by more than the cost of the corresponding advertising and promotion programs. Williams, Capps, and Hanselka (2018) demonstrate that the reported returns to producers across a broad range of commodity advertising and promotion programs per dollar spent on promotion has been in the range of about \$4 to \$17. They also calculate a weighted average return on investment of close to \$7 per dollar spent on promotion across various commodity promotion programs. That is, in general, commodity advertising and promotion has been found to generate returns to producers (and/or other stakeholders) by more than enough to cover the costs of the respective advertising and promotion activities.

### **Measuring the Effectiveness of the Pecan Checkoff Program**

The first step in the process of measuring the effects of pecan promotion activities on U.S. pecan markets and the return to stakeholders is to modify PecanMod, a simulation model of the U.S. pecan industry developed by Capps and Williams (2019), to account for the effects pecan promotion activities since the last report (Williams and Capps, 2021). This process requires a re-estimation of the econometric equations in PecanMod associated with domestic and export demand to account for demand-enhancing domestic and international marketing and promotion activities.

Econometric analysis allows the measurement of this relationship between pecan promotion expenditures and the domestic and export demands for pecans through accounting for other factors that may affect each demand. In this way, we isolate the specific effect of promotion expenditures on those demands. The econometric analysis covers the fiscal years 1980/81 through 2023/24. The result of this process is a measure of the change in U.S. domestic pecan and export demand in response to domestic and export pecan promotion over that period.

The next step in the process is to use PecanMod to simulate pecan price and markets effects over that period resulting from domestic and export demand promotion expenditures. The simulation results allow the measurement of the contribution of the promotion expenditures not only to the levels of U.S. pecan supplies, demands, and prices but also to pecan producer revenue and profit over the study period. In this analysis, we measure the effects of pecan promotion over the period 2020/21 to 2023/24. In the previous report by Capps and Williams (2021), the effects of pecan promotion were ascertained over the period 2016/17 to 2019/20.

The last step in this process is the use of the results from the first two steps to calculate the return to pecan growers, shellers, and importers associated with their investment in pecan promotional activities over the period 2020/21 to 2023/24. Even if the pecan promotion



expenditures successfully increased the demand for U.S. pecans, the important question for U.S. pecan stakeholders is whether the cost to them of the checkoff assessments they have paid as investments in pecan promotion has outweighed the additional revenues and/or profit that they may have earned because of the program. Put another way, growers, shellers, and importers want to know what the return has been to the dollars they have contributed to promoting U.S. pecans and, therefore, whether those funds might have been more profitably invested elsewhere. Addressing these questions requires a benefit-cost analysis of the returns to pecan producers from the additional revenues and profit generated by pecan promotion expenditures. To that end, pertinent benefit-cost ratios (BCR) for the domestic and export demand promotion programs over 2020/21 through 2023/24 (the study period) are calculated that represent economic measures of return on investment (ROI) to marketing and promotion expenditures.

### *Econometric Methodology*

PecanMod is a structural/economic model or economic representation of the U.S. pecan industry. The basic structure of the model is depicted in Figure 3<sup>4</sup>. In the model, the supply-side activities (utilized native/seedling and improved variety pecan production (in-shell and converted to a shelled basis), beginning stocks, and imports) at the top of Figure 3 interact with demand-side activities (domestic utilization, export demand, and ending stocks) at the bottom of Figure 3 to determine producer prices (native/seedling, improved, and weighted average of these varieties) as well as export and import prices in a given year in the middle of Figure 3. The producer prices in that year then affect the production of improved and native/seedling pecans in the following year (dotted lines represent time lags). Together with import supplies and beginning stocks in the following year (which are ending stocks in the previous year), production in the following year interacts with demand activities in that year to determine prices in that year which then impact production in the following year and so on. Because no retail price of pecans is available, the producer price (shelled basis) is used in the model as a proxy. We assume that these two prices are positively correlated.

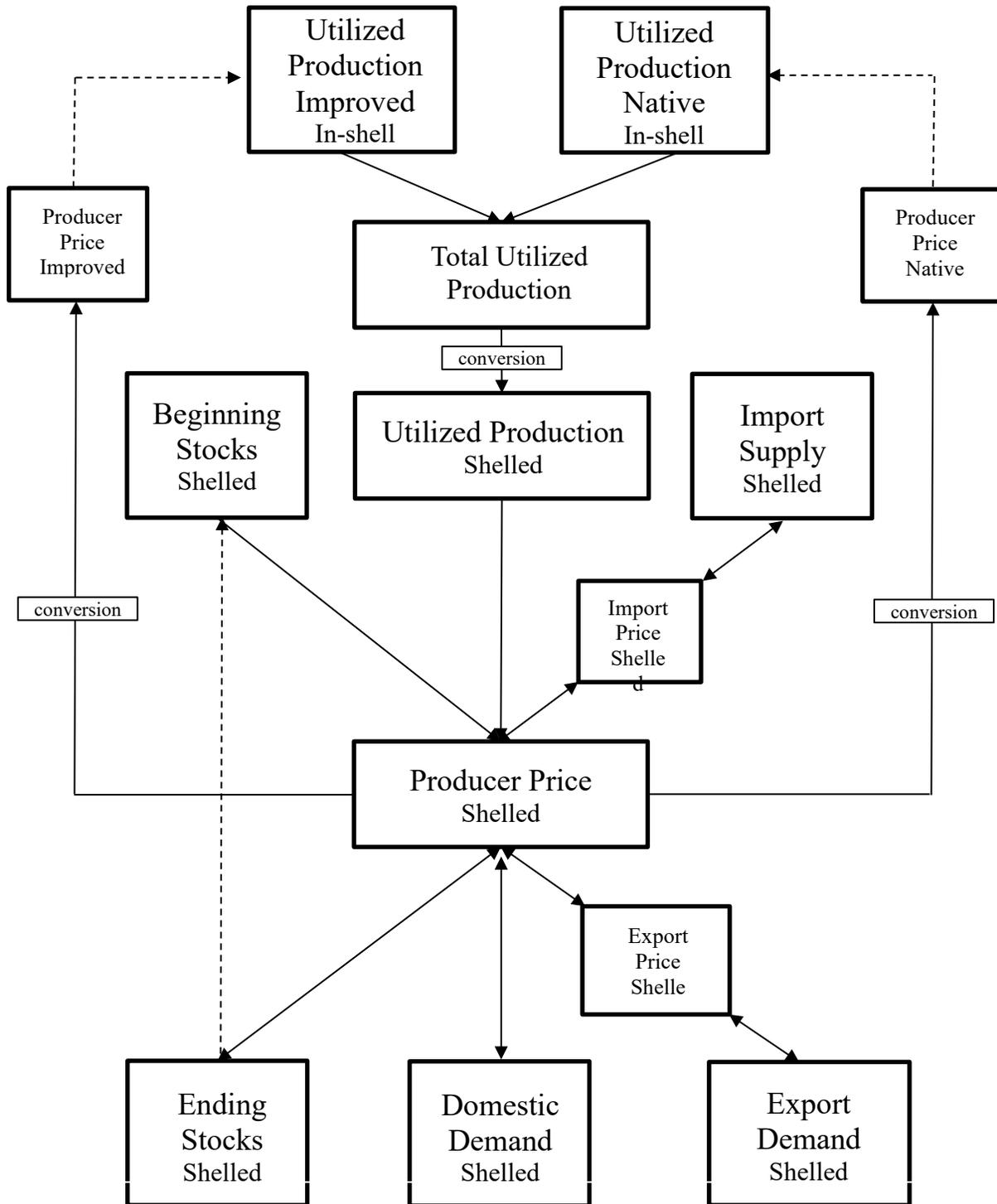
The schematic representation of PecanMod is laid out as a set of 14 structural equations as exhibited in Figure 4. The variable names are defined and presented in Figure 5. The relationships associated with six key industry activities are expressed in equations (1) and (2) (improved and native/seedling pecan production), equation (5) (pecan import supply), equation (6) (domestic pecan utilization), equation (7) (ending stock demand), and equation (8) (pecan export demand) in Figure 4. Equations (10) through (14) represent the various price linkages in the model. Four of the equations in PecanMod as represented in Figure 4 are identities to link various activities such as the addition of native/seedling and improved in-shell pecan supplies into a total in-shell pecan supply in equation (3), the conversion of total in-shell supply to shelled supply in equation (4), and the conversion of the shelled producer price to an in-shell basis in equation (14). Equation (9) is a market clearing condition requiring that total supply of shelled pecans equal the total demand for shelled pecans in each year. In the other ten equations, we identify statistically significant drivers of each market activity. The estimated coefficients (structural parameters) provide measures of the change in each market activity in the model from a change in the respective explanatory variable.

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<sup>4</sup> See Capps and Williams (2019) for more details on PecanMod.



Figure 3: The Structure of the Simulation Model PecanMod





**Figure 4: PecanMod Structural Equations**

(1)	$S_i = S_i (P_i^c, \alpha_{si})$	Improved pecan production (in-shell)
(2)	$S_n = S_n (P_n^c, \alpha_{sn})$	Native pecan production (in-shell)
(3)	$S_p = S_i + S_n$	Total in-shell pecan production identity (in-shell)
(4)	$S_u = \emptyset S_p$	Total utilized production (in-shell conversion to shelled identity) ( $\emptyset$ = conversion rate)
(5)	$S_m = S_m (P_m, \alpha_{sm})$	Import pecan supply (shelled)
(6)	$D_u = D_u (P_u, \beta_{du})$	Domestic pecan utilization (shelled)
(7)	$E_u = E_u (P_u, \beta_{eu})$	Ending stock demand for pecans (shelled)
(8)	$D_x = D_x (P_x, \beta_{dx})$	Export demand for pecans (shelled)
(9)	$E_{ut-1} + S_u + S_m = D_u + D_x + E_u$	Market clearing condition (shelled)
(10)	$P_i = P_i (P_u / \emptyset, \theta_{pi})$	Price linkage ( $P_{\text{improved}}$ to $P_{\text{shelled market}}$ )
(11)	$P_n = P_n (P_u / \emptyset, \theta_{pn})$	Price linkage ( $P_{\text{native}}$ to $P_{\text{shelled market}}$ )
(12)	$P_m = P_m (P_u, \theta_{pm})$	Price linkage ( $P_{\text{import}}$ to $P_{\text{shelled market}}$ )
(13)	$P_x = P_x (P_u (1+\tau), \theta_{px})$	Price linkage ( $P_{\text{export}}$ to $P_{\text{shelled market}}$ )
(14)	$P_p = \emptyset P_u$	Price linkage ( $P_{\text{unshelled}}$ to $P_{\text{shelled}}$ )
14 unknowns: $S_i, S_n, S_p, S_u, S_m, D_u, E_u, D_x, P_i, P_n, P_m, P_x, P_u, P_p$		

**Figure 5: PecanMod Variable Definitions**

<b>Endogenous Variables:</b>	
$S_i$	= U.S. improved pecan production (in-shell basis)
$S_n$	= U.S. native pecan production (in-shell basis)
$S_p$	= U.S. total in-shell production (in-shell basis)
$S_u$	= U.S. total utilized production (in-shell converted to shelled)
$S_m$	= U.S. pecan import supply (shelled basis)
$D_u$	= U.S. domestic pecan utilization (shelled basis)
$E_u$	= U.S. ending stock demand for pecans (shelled basis)
$D_x$	= U.S. export demand for pecans (shelled basis)
$P_i$	= U.S. producer price of improved pecan varieties (in-shell)
$P_n$	= U.S. producer price of native pecans (in-shell basis)
$P_m$	= U.S. price (import unit value) of imported pecans (shelled basis)
$P_x$	= U.S. price (export unit value) of exported pecans (shelled basis)
$P_u$	= U.S. average producer pecan price (shelled basis)
$P_p$	= U.S. average producer pecan price (in-shell basis)
<b>Exogenous Variables:</b>	
$\emptyset$	= conversion rate (in-shell to shelled)
$\alpha$	= exogenous drivers (shift variables) of the respective supply equations, including variables like inflation, prices of competing crops, technological change, etc.
$\beta$	= exogenous drivers (shift variables) of the respective demand equations, including variables like income, prices of other nuts, population, inflation, etc. where $\beta_{du}$ and $\beta_{dx}$ are, respectively, domestic pecan demand promotion and pecan export demand promotion.
$\theta$	= exogenous drivers (shift variables) of the respective price equations, including variables like exchange rates, transportation costs, etc.



Equations (6) and (8) in the model in Figure 4, representing domestic demand for pecans and export demand for pecans, include the effects of marketing and promotional activities expressed in terms of dollars. In essence, the marketing and promotional expenditures are added to those two equations as shift variables ( $\beta_{du}$  and  $\beta_{dx}$ , respectively). The rich history of the analysis of generic advertising and promotion programs has demonstrated rather conclusively that such promotion programs have carryover effects as discussed earlier. That is, the impact of promotion expenditures typically is not felt at once but instead is distributed over several periods. Thus, to represent the effects of promotion expenditures over time, “goodwill” variables ( $G$ ) are constructed as distributed lag structures. For domestic and export demand, the goodwill variables at time  $t$  ( $G_{du,t}$  and  $G_{dx,t}$ , respectively) are constructed as:

$$(1) \quad G_{du,t} = \sum_{i=0}^m w_i f[\beta_{du,t-i}]$$

$$(2) \quad G_{dx,t} = \sum_{i=0}^m w_i f[\beta_{dx,t-i}]$$

where  $\beta_{du,t-i}$  refers to current and lagged domestic demand promotion expenditures for lags  $i = 0, 1, \dots, m$ ,  $\beta_{dx,t-i}$  refers to current and lagged export demand promotion expenditures for lags  $i = 0, 1, \dots, m$ ,  $w_i$  are lag weights, and  $f$  corresponds to a square root transformation or to a logarithmic transformation to account for the diminishing returns to promotion expenditures. Additionally, the promotion expenditures in each the domestic and export demand equation ( $\beta_{du}$  and  $\beta_{dx}$ , respectively) must account for the effects of inflation. To handle this issue, we divide the nominal promotion expenditures by the Consumer Price Index or the Implicit GDP Price Deflator.

The resulting structure of  $G$  in each demand equation allows for carryover effects of advertising on demand. To account for these carryover effects and determine the lag weights ( $w_i$ ), we use the Almon polynomial distributed lag (PDL) formulation commonly used in the analysis of advertising effectiveness (see, for example, Williams, Capps, and Dang, 2010; and Capps and Williams, 2021). Theory provides relatively little guidance as to the structure and length of these dynamic processes. Conventionally, we use statistical criteria like the Akaike Information Criterion (AIC), the Schwarz Loss Criterion (SLC) or the Hannan-Quinn Criterion (HQC), allowing the data to suggest the optimal number of lags (the subscript  $i$  in equations (1) and (2)) to include in the specification to represent the carryover effects.

The use of the PDL formulation eliminates collinearity among the lagged promotion variables and saves degrees of freedom associated with estimation of the model. The PDL structure reveals the nature of the effect of the respective promotion expenditures on the U.S. and export demands for U.S. pecans. For each lag formulation and each demand equation, lags of up to four years are considered and for the PDL, up to third degree polynomials with alternative choices of head and tail restrictions.

### *Counter-Factual Simulation Methodology*

The first objective of this study is to answer the question: What have been the effects of the pecan checkoff program administered over the period since the previous report (2020/21 through 2023/24)? To answer that question, we use PecanMod with reliance on the domestic and export demand equations to conduct a counterfactual simulation analysis over the study period 2020/21 to 2023/24. The process of analyzing the effects of promotion on markets is referred to as counter-factual simulation. The “simulation” of a model is simply the mathematical solution of a



set of equations, such as the 14 equations of PecanMod. Baseline simulation refers to the simulation of the model to determine how closely the model replicates the actual historical values of the variables in the model, such as the supply, demand, trade, and price variables in PecanMod, over history. A baseline simulation of PecanMod was conducted previously by Williams and Capps (2019). They report that the model tracks the historical functioning of the U.S. pecan industry extremely well.

A counterfactual simulation analysis requires two simulations of the model. The first simulation assumes that nothing has changed over the period of analysis, that is, nothing in the market is different than what occurred historically. This simulation is just the *baseline* simulation generated to determine the validity of the model. In the context of a counterfactual analysis, the baseline simulation is referred to as the “with” simulation because the simulated values of the industry variables (supply, demand, price, etc.) include the effects of the event being analyzed (in this case the effect of pecan demand promotion). Thus, the *with* scenario represents the level of supply, demand, prices, trade, etc. in the U.S. pecan industry that **include** any effects on those markets associated with domestic and export promotion.

The second scenario simulated with the model in a counter-factual analysis is referred to as the *without* scenario analysis and is conducted by setting the values of expenditures to promote U.S. pecan demand to zero and then simulating the model again over the same time period to generate new values for the industry variables (production, utilization, trade, prices, etc.). Because the new levels of the variables in the model in the *without* scenario are generated by changing only the level of pecan promotion in domestic and export markets, they represent the levels of the prices and quantities that would have occurred in the industry over history if promotion had not occurred. In the case of expenditures to promote pecan demand (domestic and/or export), the *without* scenario assumes that such expenditures never occurred over the study period. The simulated levels of the industry variables (supply demand, prices, etc.) in this scenario, therefore, represent the levels of those variables that would have occurred during those years if there had been no effort to promote pecans domestically or in foreign markets.

Differences in the simulated levels of the industry variables in the model (supplies, demand, prices, trade, etc.) in the *with* scenario from those in the *without* scenario are then taken as direct measures of the effects of pecan demand promotion (domestic and/or export). Because no other exogenous variable in the model (e.g., level of inflation, exchange rates, income levels, agricultural and trade policies, etc.) other than expenditures associated with pecan demand promotion is allowed to change in either scenario, this process effectively isolates the effects of demand promotion on the pecan industry. That is, the simulated differences between the values of the endogenous (industry) variables from the *with* scenario and from the *without* scenario provide direct measures of the historical effects of the marketing and promotional activities (and **only** these activities).

The price and quantity effects in the counter-factual simulation depend critically on several parameters in the model, including most importantly: (1) the responsiveness of the U.S. pecan production to price changes; (2) the responsiveness of U.S. pecan demand to price changes (that is, the own price elasticity of U.S. pecan demand); (3) the price responsiveness of export demand for U.S. pecans (that is, the U.S. pecan export demand price elasticity); (4) the price responsiveness of U.S. pecan imports (that is, the price elasticity of U.S. pecan import supply); (5) the price responsiveness of U.S. pecan inventories; (6) the responsiveness of U.S. pecan demand and of



U.S. export demand to promotion expenditures (that is, the domestic and export demand marketing and promotion elasticities); and (7) the level of marketing and promotion expenditures available for domestic and export demand promotion.

### *Benefit-Cost Analysis Methodology*

The results of the counterfactual analysis are used in a benefit-cost analysis to achieve the second objective of this study by answering the question: Have the promotion expenditures over the period 2020/21 to 2023/24 benefited pecan growers, shellers, and importers who pay the assessments that are used to promote pecans? If the econometric and counterfactual analyses determine that there has been little or no impact of pecan promotion expenditures on domestic or export demand for U.S. pecans, then obviously U.S. pecan producers have received little or no benefit from their investment in pecan promotion. If the analyses determine that promotion has indeed enhanced the demand (domestic and/or export) for U.S. pecans, then the critical question is whether the gains realized by pecan producers because of the promotion expenditures have been sufficient to more than pay for their costs in financing the promotion.

That is, has the pecan checkoff program run at a loss or profit from the perspective of the stakeholders who paid for the promotion? Have the market effects induced by promotion expenditures over the study period been substantial enough to generate sufficient additional returns to stakeholders to more than cover their cost of financing the promotion? If not, then the conclusion would be that the program should be discontinued because the program costs are greater than the returns. On the other hand, if the returns generated more than cover the costs, the program would be deemed a successful investment opportunity for pecan growers, shellers, and importers.

To measure the return to pecan stakeholders from their investments in pecan demand promotion, the incremental revenue and profit from that promotion program as discussed earlier are calculated using the results of the counterfactual simulation analysis. The differences between the levels of producer revenue and profit assuming there has been no pecan promotion (calculated using the *without promotion* counterfactual simulation scenario results) are subtracted from the levels of producer revenue and profit that producers actually received (the *with promotion* scenario results) are the measures of the “benefit” to producers in calculating benefit-cost ratios (BCRs) to U.S. pecan producers over the study period.

Two BCRs are calculated in this study over the study period linked to pecan demand promotion: (1) the Net Revenue BCR (NBCR), and (2) the net economic surplus or profit BCR (SBCR). The NBCR is calculated as the additional producer revenue generated over the period of promotion (R) net of the cost of the promotion (E) per dollar of promotion expenditure (E) over that period:

$$(3) \text{ NBCR} = \frac{\sum_{t=1}^T R_t - E_t}{\sum_{t=1}^T E_t} .$$

The SBCR is calculated by replacing the R (the additional producer industry revenue because of promotion) in equation (3) with the additional profit earned by the industry as a result of the promotion (S) calculated as:



$$(4) \text{ SBCR} = \frac{\sum_{t=1}^T S_t - E_t}{\sum_{t=1}^T E_t} .$$

The BCRs provide measures of the net revenue (equation (3)) or the profit (equation (4)) earned by U.S. pecan producers per dollar expenditures on pecan promotion. For the purposes of generic promotion program evaluations, a net BCR of greater than 1.0 (accounting for the cost of the marketing and promotion activities) indicates that these efforts have benefited producers because the benefit they earn from the promotion (net revenue and/or profit) increases by more than one dollar for every dollar spent on promotion over the period of analysis. On the other hand, a net BCR of less than 1 indicates that the promotion has been an unprofitable investment for producers since each dollar spent generates less than a dollar in additional benefit (net revenue or profit) over the study period 2020/21 to 2023/24.

## ECONOMIC EVALUATION OF THE EFFECTIVENESS OF PECAN PROMOTION

The economic evaluation of the pecan checkoff program follows the methodology outlined in the preceding section. In this section, the results of the econometric analysis of the effects of the pecan promotion on U.S. domestic and export demands for pecans are first presented. The econometric results are then used in a counterfactual simulation analysis of the impacts of pecan promotion on U.S. pecan markets, prices, and trade since the program's implementation. Finally, the simulation results are used in a benefit-cost analysis to determine the ROI to those stakeholders who pay the assessments for marketing and promotion activities.

### Econometric Analysis of U.S. Pecan Demand and Promotion

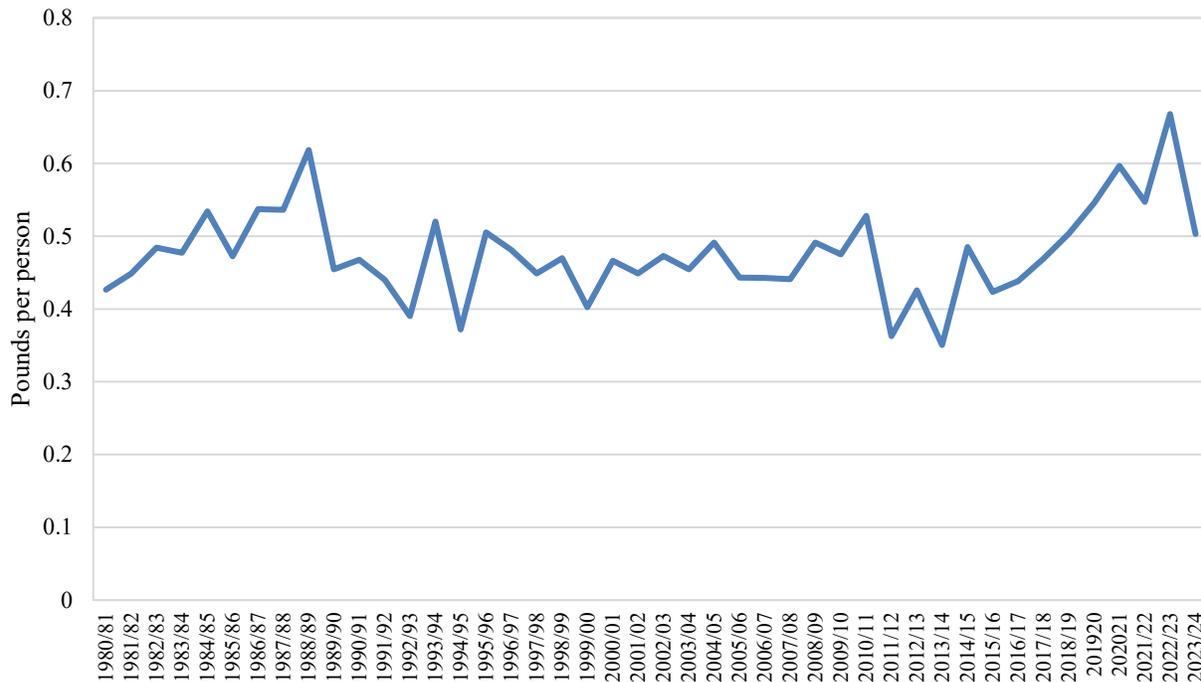
#### *Domestic Pecan Demand and Promotion*

The econometric analysis of domestic pecan demand covers the October/September marketing years of 1980/81 to 2023/24. The dependent variable in the econometric analysis is the per capita domestic use of pecans on a shelled basis to account for the effects of population. As exhibited in Figure 6, per capita domestic use of pecans ranged from 0.35 pounds to 0.67 pounds over the period 1980/81 to 2023/24, averaging almost 0.48 pounds over that period.

The set of explanatory factors in this econometric analysis include: (1) the nominal season average grower price of pecans (weighted average, shelled basis, measured in cents per pound); (2) the nominal season average grower price of almonds (shelled basis, measured in cents per pound); (3) the nominal season average grower price of walnuts (shelled basis, measured in cents per pound); (4) the nominal season average grower price of pistachios (shelled basis, measured in cents per pound); (5) real per capita disposable income in 2017 dollars; (6) the Consumer Price Index (CPI) (1982-84=100) to account for inflation; (7) a trend variable (0, 1, 2, ...), a proxy to account for tastes and preferences; (8) dummy variables or indicator variables for years 1984, 1988, 1994, 1999, 2010, 2013, and 2022 (D1984, D1988, D1994, D1999, D2010, D2013, and D2022) to account for qualitative events, and (9) nominal demand-enhancing domestic program expenditures in dollars. The data sources include the Fruit and Tree Nuts Yearbook (USDA, 2025a), the Non-Citrus Fruits and Nuts Summary (USDA, various issues), the Federal Reserve Economic Data Base (FRED) (2025) for macroeconomic variables such as disposable personal income and the Consumer Price Index, and Brandon Drummond, Director of Finance of the APC and APPB for the level of expenditures for domestic marketing and promotion activities.



**Figure 6: Per Capita Domestic Use of Pecans, 1980/81-2023/24, Shelled Basis (Pounds)**



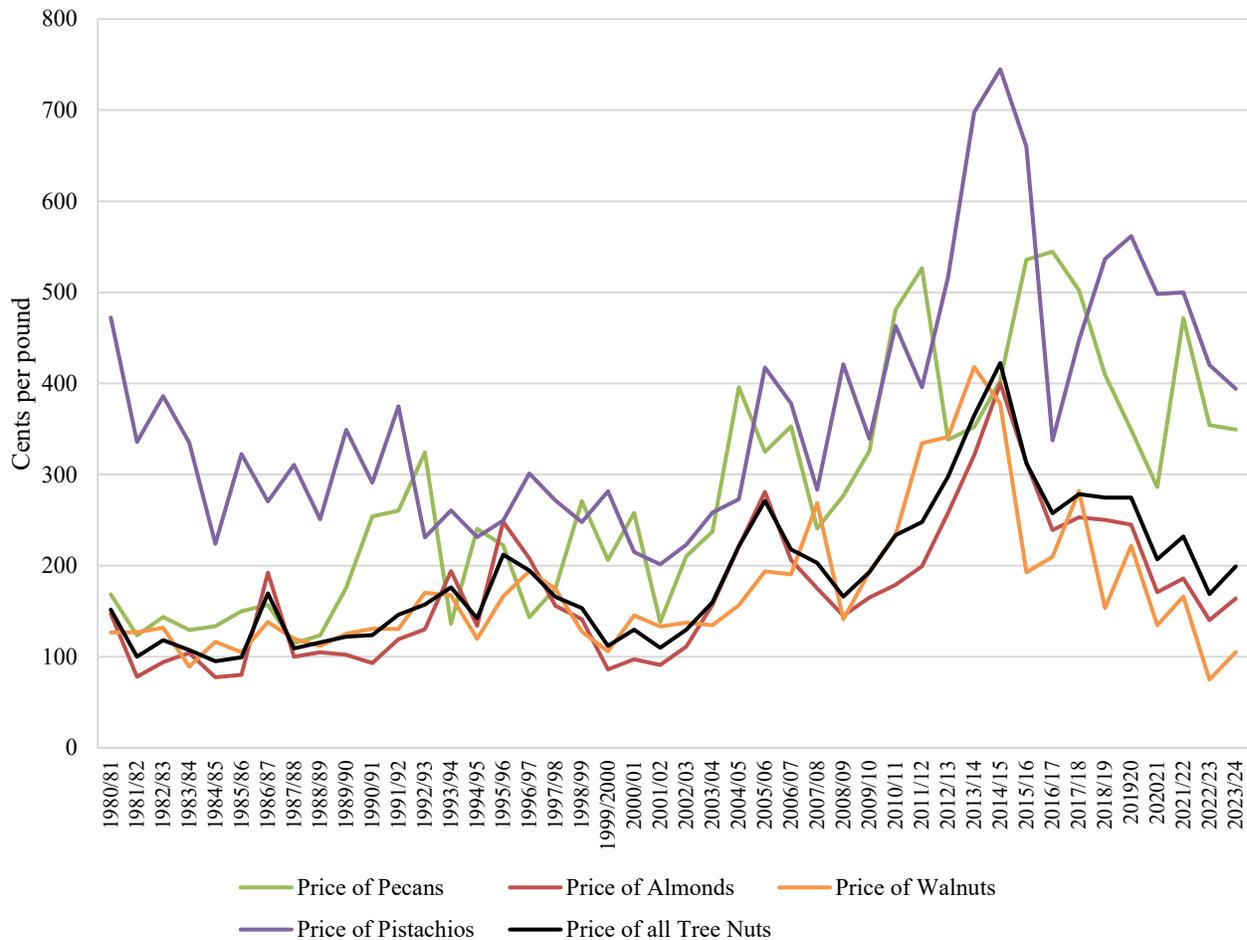
Source: USDA (2025b).

The weighted average nominal price of pecans ranges from 114.80 cents per pound to 544.70 cents per pound over the period 1980/81 to 2023/24, averaging 279.88 cents per pound. The nominal prices of almonds, walnuts, and pistachios range from 77.40 cents per pound to 400.00 cents per pound, 76.75 cents per pound to 417.90 cents per pound, and 132.49 cents per pound to 744.90 cents per pound respectively over the same period, averaging 171.71 cents per pound for almonds, 173.02 cents per pound for walnuts, and 367.73 cents for pistachios. Over the period 1980/81 to 2023/24, average grower prices for pistachios are the highest among tree nuts, followed by grower prices for pecans. On average, grower prices for almonds and walnuts are very similar at close to 170 cents per pound. In Figure 7, we depict graphically the respective prices of pecans, almonds, walnuts, pistachios, and all tree nuts over the study period.

Real per capita disposable personal income, measured in 2017 dollars, varies from \$23,069 to \$51,615 over that period, averaging \$36,324. From 2016/17 through 2023/24, domestic marketing and promotion expenditures amounted to \$1,751,942 in 2016/17, \$7,101,745 in 2017/18, \$5,735,689 in 2018/19, \$4,022,097 in 2019/20, \$7,411,962 in 2020/21, \$3,071,557 in 2021/22, \$1,394,292 in 2022/23, and \$918,806 in 2023/24. From 1980/81 through 2015/16, pecan promotion expenditures are zero. Over the period 2016/17 to 2019/20, the level of domestic promotion expenditure on pecans was \$18,611,473 cumulatively. Over the period 2020/21 to 2023/24, the level of domestic promotion expenditure on pecans was roughly two-thirds of the previous four-year period at \$12,795,717.



**Figure 7: Graphical Depiction of Prices Received by Growers Over the Period 1980/81 to 2023/24, Cents Per Pound on a Shelled Basis**



Source: USDA (2025a).

The estimated coefficients, standard errors, t-statistics, and p-values associated with the econometric analysis are presented in Table 1. The goodness-of-fit metric ( $R^2$ ) is 0.85, meaning that this model accounts for 85% of the variability in per capita domestic use of pecans. The level of significance chosen for this analysis is 0.10 given the sparse size of the sample of observations. As such, the respective estimated coefficients of the model are statistically different from zero except for the real price of pistachios (the ratio of the nominal price of pistachios to the CPI), real per capita income, and trend. Further, the standard error of the regression is 0.0617, another indicator of goodness-of-fit. Finally, based on the Durbin-Watson statistic ( $DW=2.31$ ), no autocorrelation is evident in the residuals. Simply put, the model concerning per capita domestic use of pecans fits the data well, with no systematic pattern in the residuals, desirable traits in any econometric analysis.

In addition, the dependent variable, the various real prices of tree nuts, and real per capita disposable income are expressed in logarithmic form. Consequently, the estimated coefficients



associated with the real (inflation-adjusted) prices of the various tree nuts and real per capita disposable income are elasticities. In particular, the own-price elasticity of domestic demand for pecans is -0.1535, the cross-price elasticity of almonds with respect to pecans is 0.1215, the cross-price elasticity of walnuts with respect to pecans is -0.1343, and the cross-price elasticity of pistachios with respect to pecans is 0.0396. Hence, the domestic demand for pecans is not very sensitive to changes in prices, that is, the demand for pecans for domestic use is inelastic in economic parlance. Based on the respective cross-price elasticities of demand, almonds and pistachios are substitutes for pecans, while walnuts are complements to pecans in economic terms. The income elasticity is 0.2526, indicative of a normal good (necessity), albeit the estimated coefficient associated with real per capita income is not statistically different from zero.

Domestic per capita use of pecans is highest for fiscal years 2010/11, 2022/23, and 1988/89 and (by roughly 23% to 28%), but lowest for fiscal years 1994/95 and 2013/14 (by roughly 20%) relative to other fiscal years. The estimated coefficient with the trend variable is negative, indicative of a slight downward trend in per capita domestic use of pecans, all other factors invariant. However, this estimated coefficient is not statistically different from zero. As such, we do not have any evidence of changes in tastes and preferences of pecans at least for domestic use.

To account for diminishing marginal returns in conjunction with domestic market promotion activities, accommodate zero values of the level of promotion over the period 1980/81 to 2023/24, and account for inflation, we employ the square root transformation of the demand-enhancing expenditures deflated by the CPI. With this transformation, the domestic promotion elasticity not only varies by year but also varies directly with the level of promotion expenditures.

To account for the carryover effects of promotion as discussed earlier, we employ the Almon polynomial distributed lag (PDL) formulation. Theory provides relatively little guidance as to the structure and length of these dynamic processes. Based on model selection criteria, namely the Akaike Information Criterion (AIC), the Schwarz Loss Criterion (SLC) or the Hannan-Quinn Criterion (HQC), we determine that the optimal lag length for *domestic* promotion expenditures is one year. Hence, the impact of domestic promotion expenditure does not occur all at once (that is, the impact is not contemporaneous) but instead is distributed over a period of one year. Importantly, the promotion elasticities are estimated to be 0.0902, 0.0559, 0.0367, and 0.0294 for the period 2020/21 to 2023/24, not only positive as hypothesized but also statistically different from zero. Bottom line, domestic marketing and promotion activities significantly and positively affect the level of domestic use of pecans. Finally, the promotion elasticities compare favorably with those estimated previously in the initial evaluation.

#### *Export Demand for Pecans and Promotion*

The econometric analysis of export demand for pecans also covers the October/September marketing years of 1980/81 to 2023/24. The dependent variable in this structural equation is U.S. pecan exports (total shelled, 1,000 pounds). As exhibited in Figure 8, the trend in U.S. pecan exports was upward from 1980/81 to 2020/21 until declining in 2021/22 and again in 2022/23. In 2023/24, U.S. pecan exports rose once more. U.S. pecan exports over the period 1980/81 to 2023/24 ranges from 2.264 million pounds to 113.474 million pounds on a shelled basis, averaging 42.641 million pounds.



**Table 1: Econometric Analysis of Per Capita Domestic Demand for Pecans, Estimated Coefficients, Standard Errors, t-statistics, and p-values, 1980/81 to 2023/24**

Domestic Demand Equation for Pecans with PDL of 1-Year Lag for Domestic Promotion  
 Dependent Variable:  
 LOG(PER\_CAPITA\_USE\_PECANS)  
 Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	p-value
C	-2.6668	4.7771	-0.56	0.5811
LOG(PRICE_PECANS*100/CPIU)	-0.1535	0.0421	-3.64	0.0011
LOG(PRICE_ALMONDS*100/CPIU)	0.1215	0.0433	2.81	0.0090
LOG(PRICE_WALNUTS*100/CPIU)	-0.1343	0.0486	-2.76	0.0100
LOG(PRICE_PISTACHIOS*100/CPIU)	0.0396	0.0460	0.86	0.3963
LOG(REAL_PCDPI)	0.2526	0.4539	0.56	0.5822
D2013	-0.2113	0.0729	-2.90	0.0072
D1988	0.2096	0.0650	3.22	0.0032
D1994	-0.2195	0.0671	-3.27	0.0028
D2022	0.2106	0.0812	2.59	0.0150
D2010	0.2461	0.0669	3.68	0.0010
D1999	-0.1515	0.0668	-2.27	0.0314
D1984	0.1382	0.0658	2.10	0.0449
@TREND	-0.0065	0.0080	-0.81	0.4244
R-squared	0.8500			
Adjusted R-squared	0.7750			
Standard Error of Regression	0.0617			
Durbin-Watson statistic	2.3105			

Lag Distribution of (DOMPROMO EXP*100/CPIU) <sup>.5</sup>	Lag Length	Coefficient	Std. Error	t-Statistic
	0	5.41E-05	1.54E-05	3.52
	1	5.41E-05	1.54E-05	3.52
	Sum of Lags	0.000108175	3.07E-05	3.52

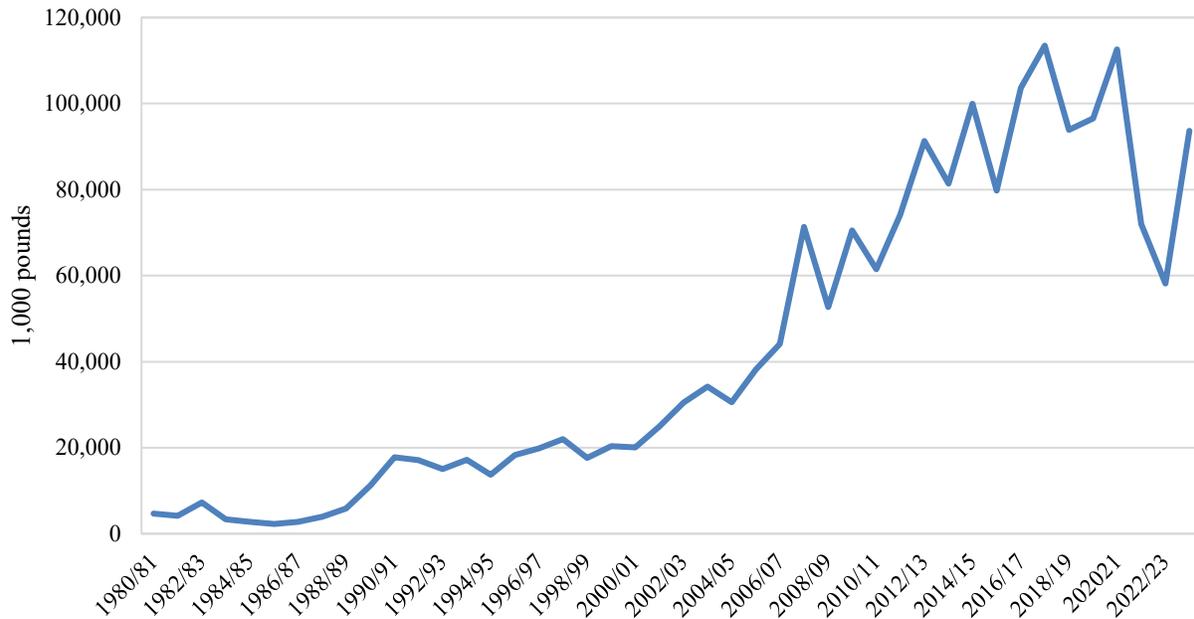
  

Domestic Promotion Elasticities by Fiscal Year	Domestic Promotion Elasticity
2020/21	<b>0.0902</b>
2021/22	<b>0.0559</b>
2022/23	<b>0.0367</b>
2023/24	<b>0.0294</b>

Source: Estimation done with EVIEWS 13.0 (2022), econometrics software package.



**Figure 8: U.S. Pecan Exports, Shelled Basis, 1980/81 to 2023/24**



Source: USDA (2025a)

The set of explanatory factors in this equation include the nominal export unit value (price per ton of U.S. pecan exports), the agricultural trade adjusted exchange rate of the U.S. dollar relative to all other currencies (2017=100), and nominal international program marketing and promotion expenditures in dollars. The specification also includes a dummy variable or indicator variable for 2022/23 designed to capture the lingering effects of the pandemic and trade restrictions, a trend variable to capture the growth in U.S. pecan exports over time, and a lag of the dependent variable designed to capture persistence or inertia in U.S. pecan exports.

On average, the nominal export unit value, as a proxy for price, is roughly \$557 per ton over the study period, ranging from \$265 per ton to \$775 per ton. The agricultural trade adjusted exchange rate of the U.S. dollar relative to all other currencies ranges from 86.54 to 116.25, averaging 100.36 over the study period.

From 2016/17 through 2023/24, foreign marketing and promotion expenditures amounted to \$1,150,069 in 2016/17, \$2,22,6817 in 2017/18, \$1,860,171 in 2018/19, \$1,353,619 in 2019/20, \$1,505,801 in 2020/21, \$1,577,519 in 2021/22, \$1,77,381 in 2022/23, and \$2,040,090 in 2023/24. The sources of the foreign or international program promotion expenditures are APC, APPB, and Foreign Agricultural Service (FAS).

The estimated coefficients, standard errors, t-statistics, and p-values associated with the econometric analysis are presented in Table 2. Based on model selection criteria, the logarithmic transformation of real export unit values, the agricultural trade adjusted exchange rate, trend, and a 1-year lag of U.S. exports, together with the square root of export promotion expenditure provides the best fit for the analysis. The goodness-of-fit metric ( $R^2$ ) is nearly 0.93, meaning that this model accounts for almost 93% of the variability in U.S. pecan exports. Also note that unlike



**Table 2: Econometric Analysis of Export Demand for Pecans, Estimated Coefficients, Standard Errors, t-statistics and p-values, 1980/81 to 2023/24**

Dependent Variable: LOG(US EXPORTS OF PECANS)

Variable	Coefficient	Std. Error	t-statistic	p-value
CONSTANT	16.0912	5.1541	3.12	0.0041
LOG(EXPORTS(-1))	0.6223	0.1500	4.15	0.0003
LOG(EXPORT_PRICE/CPI)	-0.6703	0.3544	-1.89	0.0690
LOG(EXCHANGE_RATE)	-1.8511	0.7084	-2.61	0.0143
LOG(TREND)	0.3148	0.1799	1.75	0.0911
D2022	-0.4936	0.05163	-9.56	0.0000
((PROMOTION)/CPI) <sup>0.5</sup>	0.000123	8.50E-05	1.45	0.1576
R-squared	0.9270			
Standard Error of Regression	0.2372			
Durbin-Watson statistic	2.0234			

Source: Estimation done with EViews Version 13.0 (2022), econometrics software package.

the model for per capita domestic use of pecans, the model for U.S. pecan exports does not support the notion of a distributed lag of foreign market promotion expenditures. That is, the impact of foreign market promotion on U.S. pecan exports is felt all at once.

The level of significance chosen for this analysis is 0.10 given the sparse size of the sample of observations. As such, the respective estimated coefficients of the model are statistically different from zero. Further, the standard error of the regression is 0.2372, another indicator of goodness-of-fit. Finally, based on the Durbin-Watson statistic (DW=2.02), no autocorrelation is evident in the residuals. Simply put, the model for U.S. pecan exports fits the data well, with no systematic pattern in the residuals, desirable traits in any econometric analysis.

The use of the lag of the dependent variable in the model for U.S. pecan exports is tantamount to a Nerlovian partial adjustment model (NPAM). The NPAM allows the estimation of short-run (one year) and long-run impacts of the explanatory variables on U.S. pecan exports. The elasticity of adjustment is equal to one minus the estimated coefficient of the lag of the dependent variable or 0.3777 in this analysis. Hence, roughly 37.8% of the adjustment to long-run equilibrium occurs within one year. To derive the long-run impacts, we multiply the short-run impacts by the reciprocal of the elasticity of adjustment or 2.647 in this case. In addition, based on this estimated elasticity of adjustment, approximately 99% of the adjustment to long-run equilibrium occurs after 10 years.

The short-run own-price elasticity of export demand for pecans is -0.6703, meaning that a 1% change in the export price is associated with a 0.67% change in the opposite direction. The implied long-run own-price elasticity of export demand is -1.7745. The short-run elasticity associated with the agricultural trade adjusted exchange rate of the U.S. dollar relative to all other currencies is -1.8511. Hence, a 1% appreciation of the U.S. dollar results in a 1.855% decline in pecan exports in the short run and a 4.90% decline in the long run, holding all other factors invariant.



To account for diminishing marginal returns in conjunction with promotion activities while accommodating zero values of the level of promotion over the years of 1980/81 to 2023/24 and adjusting for inflation, we employ the square root transformation of deflated expenditures for international marketing. With this transformation, the export promotion elasticity not only varies by year but also varies directly with the level of promotion expenditures. The estimated export promotion elasticities for U.S. pecans over the study period are, respectively, 0.0835 for 2020/21, 0.0832 for 2021/22, 0.0853 for 2022/23, and 0.0896 for 2023/24, notably roughly four times larger in magnitude than the export promotion elasticities in the initial evaluation (0.0234 for 2016/17, 0.0321 for 2017/18, 0.0291 for 2018/19, and 0.0246 for 2019/20).

### *Econometric Analysis of U.S. Pecan Imports*

Import demand modeling parallels export demand modeling, but instead of examining total U.S. exports of pecans to the world, we focus on the determinants of U.S. pecan imports into individual regions or countries. Investments in foreign market development have been made in China, the EU (particularly the Netherlands), India, and the United Kingdom. In this econometric analysis, we rely on data pertaining to these major importers of U.S. pecans over the period 2000/01 to 2024/25. To increase sample size and provide a pseudo-control group, we also include regions without marketing and promotional activities, namely Canada, Mexico, South Korea, and the rest of the world (ROW). In total, the panel dataset consists of eight regions over 25 years, yielding 200 observations for the econometric analysis.

Using this panel dataset (with both time-series and cross-sectional variation), we estimate a pooled import demand model wherein the dependent variable corresponds to the annual volume of U.S. pecan imports (in-shell) for each region expressed in metric tons, labeled as IMPORTS. Explanatory variables entertained in the econometric analysis include: (1) unit value (CIF price per metric ton) of U.S. pecan imports for each region adjusted for inflation, labeled as PIS/CPI; (2) world (excluding the United States) real gross domestic product (GDP) expressed in 2010 billion dollars, labeled as GDP; (3) annual real agricultural trade adjusted exchange rate (ER) of each region's currency relative to the U.S. dollar (base year=2017), labeled as ER; (4) the Consumer Price Index (base year=2017), labeled as CPI; (5) lagged imports of U.S. pecans in each region, labeled as IMPORTS(-1); (6) indicator variables or dummy variables reflecting qualitative effects such as the pandemic or trade disruptions; and (7) nominal U.S. export promotion expenditures from the APC/APPB as well as FAS/USDA allocated to each region, labeled as PROMOTION.

U.S. pecan prices are calculated as unit values (total import value divided by quantity) per metric ton. Consistent with economic theory, U.S. pecan prices are expected to be negatively related to import volumes. World GDP excluding the United States should be positively related to the demand for pecan imports. The exchange rate is expected to be inversely related to import demand of pecans. To illustrate, a weaker dollar makes U.S. pecans less expensive, thereby increasing imports. Lagged imports capture trade persistence (inertia), while indicator variables account for disruptions attributed to the pandemic, trade policy shocks, and other factors indigenous to the international arena. U.S. export promotion expenditures from APC/APPB and FAS/USDA are aggregated and are expected to be positively related to demand for U.S. pecans. All monetary variables are deflated using each region's Consumer Price Index to remove inflation effects. Data sources for this analysis include the Trade Data Monitor (TDM);



the Federal Reserve Economic Database (FRED) for macroeconomic indicators; USDA/ERS international macroeconomic datasets; and the APC/APPB for data associated with export promotion expenditures.

In Table 3, we provide the details of the econometric analysis of the import demand for in-shell pecans. Based on model selection criteria, the logarithmic transformation of all variables together with the square root of export promotion expenditure provides the best fit for the analysis. The goodness-of-fit metric ( $R^2$ ) is nearly 0.86, meaning that this model accounts for almost 86% of the variability in U.S. pecan imports in-shell. Additionally, this model for U.S. pecan imports does not support the notion of a distributed lag of foreign market promotion expenditures. That is, the impact of foreign market promotion on U.S. pecan imports is contemporaneous.

The level of significance chosen for this analysis is 0.10 like the previous reported econometric specifications dealing with domestic per capita use of pecans and U.S. exports of pecans. Further, the standard error of the regression is 1.3756, another indicator of goodness-of-fit. Finally, based on the Durbin-Watson statistic ( $DW=2.30$ ), no autocorrelation is evident in the residuals. Simply put, the pooled time-series and cross-sectional model for U.S. pecan imports in-shell fits the data well, with no systematic pattern in the residuals, desirable traits in any econometric analysis. In this analysis, we use a fixed-effects model with cross-sectional weights. All variables, except for the U.S. import unit value for in-shell pecans, have statistically significant impacts on U.S. pecan imports.

The use of the lag of the dependent variable in the model for U.S. pecan imports is tantamount to a Nerlovian partial adjustment model (NPAM), analogous to the export demand model for U.S. pecans discussed previously. Again, the NPAM allows the estimation of short-run (one year) and long-run impacts of the explanatory variables on U.S. pecan imports. The elasticity of adjustment is equal to one minus the estimated coefficient of the lag of the dependent variable or 0.4899 in this analysis. Hence, roughly 49% of the adjustment to long-run equilibrium occurs within one year. To derive the long-run impacts, we multiply the short-run impacts by the reciprocal of the elasticity of adjustment or 2.041 in this case. In addition, based on this estimated elasticity of adjustment, approximately 99% of the adjustment to long-run equilibrium occurs after 7 years.

The short-run own-price elasticity of in-shell import demand is  $-0.265$ , meaning a 1% increase in U.S. price is associated with a 0.265% decrease in imports. The implied long-run own-price elasticity of import demand is  $-0.541$ . This own-price elasticity associated with import demand for pecans is more inelastic (less price responsive) than the own-price elasticity of export demand model for pecans.

A 1% increase in GDP is associated with a 1.41% increase in U.S. imports of pecans, holding all other demand drivers constant. The implied long-run elasticity is 2.883. As such, U.S. imports of imports are very sensitive to changes in world GDP excluding the United States. The estimated short-run elasticity with respect to the exchange rate is  $-0.875$ , and the long-run



**Table 3: Econometric Analysis of Import Demand for Pecans (In-shell), Estimated Coefficients, Standard Errors, t-statistics, and p-values, 2000/01 to 2024/25**

Dependent Variable: LOG(IMPORTS)  
 Method: Panel EGLS (Cross-section weights)  
 Periods included: 25  
 Cross-sections included: 8  
 Total panel (balanced) observations: 200

Variable	Coefficient	Std. Error	t-statistic	p-value
CONSTANT	-5.5537	3.6102	-1.54	0.1679
LOG(IMPORTS(-1))	0.5101	0.1228	4.15	0.0043
LOG(PIS/CPI)	-0.2650	0.3032	-0.87	0.4110
LOG(GDP)	1.4126	0.5189	2.72	0.0297
LOG(ER)	-0.8748	0.5197	-1.68	0.1362
D2022—dummy variable for 2022/23	-0.9138	0.3103	-2.95	0.0216
((PROMOTION)/CPI) <sup>0.5</sup>	0.0110	0.0025	4.40	0.0032
R-squared	0.8593			
Adjusted R-squared	0.8491			
Standard Error of Regression	1.3756			
Durbin-Watson stat	2.2955			

Source: Estimation done using EVIEWS Version 13.0 (2022) econometrics software package.

elasticity is  $-1.786$ . Thus, a 1% appreciation of the U.S. dollar results in a 0.875% decline in in-shell pecan imports in the short run and a 1.786% decline in the long run. The coefficient associated with indicator variable for 2022/23 is negative and statistically significant. Relative to other fiscal years in this analysis U.S. imports for in-shell pecans in 2022/23 was lower by 60%, likely due to the lingering effects of the pandemic and trade restrictions.

Promotion effects are modeled using the square-root of inflation-adjusted international marketing expenditures to allow for diminishing marginal returns and accommodate years with zero spending. Based on the estimated coefficient associated with international promotion exhibited in Table 3, foreign marketing expenditures positively and significantly impact the demand for U.S. pecan imports. On average, the estimated promotion elasticities for the period of 2020/21 to 2023/24 for the four regions wherein international marketing programs operate are as follows: (1) United Kingdom, 0.594; (2) China 0.315; (3) the Netherlands, 0.307; and (4) India, 0.306. The magnitudes of these promotional elasticities are much larger than for the domestic market as well as for the export market taken as a whole.

### Counterfactual Simulation Analysis of the Pecan Promotion Program

To conduct the counterfactual simulation analysis, we rely on the price and promotion elasticities derived from the econometric analysis of domestic demand and export demand for pecans. The results of the counterfactual simulation analysis are exhibited in Table 4. These results are referred to as the “lift” provided by pecan promotion to the U.S. pecan industry over the period



2020/21 to 2023/24<sup>5</sup>. In general, the “lift” achieved by a promotion program is the addition to price, consumption, producer revenue, profit or other industry measures. In Table 4, we provide changes from domestic promotion, changes from export promotion, and the total change attributed to promotion.

The salient result from this analysis is that pecan promotion over this period worked to support pecan prices and, thus producer revenue and profit, at higher levels than would have been the case without the promotion. That is, marketing and promotional activities created a positive lift for pecan producer prices and revenue. As shown in Table 4, domestic and export promotion together was responsible for a 23.3¢ per pound lift (13.2%) in the U.S. weighted average pecan price (weighted average of native/seedling and improved pecan prices) received by growers over the period 2020/21 to 2023/24. Given that pecan prices were higher than would have happened without promotion, pecan producer net profit also was \$282.5 million (13.7%) higher over the same four years (2020/21 to 2023/24) than would have been the case without promotion.

Further, as delineated in Table 4, the domestic and export promotion of pecans created just over a 3% lift in domestic pecan utilization over the same four-year period of about 24.8 million pounds (shelled basis). Roughly 5.1 million pounds, shelled basis, of the lift in domestic utilization was attributed to the re-direction of pecans from exports into the domestic market due to the promotion, while 20.7 million pounds, shelled basis was attributed to imports over the study period (2020/21 to 2023/24). Only about 1.0 million pounds (shelled basis) of the lift was from the increase in utilized production of native pecans. These results are consistent with the discussion presented earlier regarding the conflicts from simultaneously promoting domestic demand and exports.

In Table 4, we also decompose the pecan promotion effects over the study period into those resulting from promotion activities in the domestic market and those resulting from export promotion<sup>6</sup>. The level of lift to the pecan industry from marketing and promotion activities in each category is largely related to the fact that over two times more funds (\$12.8 million) were expended on domestic market promotion than on export promotion (\$5.9 million) over the study period. That ratio is substantially lower than the 4 to 1 ratio over the period 2016/17 to 2019/20 as reported in the previous study (Williams and Capps, 2021). Domestic and export demand worked together to lift the domestic producer price of pecans by 23.4¢ per pound, 16.6¢ per pound because of domestic promotion and another 6.8¢ per pound because of export promotion.

At the same time, however, domestic market promotion and export market promotion conflicted to some extent in their market effects. Domestic promotion provided a 29.4-million-pound lift (shelled basis) (3.9%) to domestic pecan utilization partly by redirecting just over 15 million pounds (shelled basis) (4.3%) from exports since few additional pecan supplies were available from domestic production because of the promotion. The domestic and export promotion programs also drew in additional pecan imports of 14.9 million pounds (3.1%) and 5.8 million pounds (1.2%),

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<sup>5</sup> Although the data for promotion expenditures are available through 2024/25, the data for many of the variables in PecanMod were still not available at the time this report was written. Thus, we were constrained to conduct the analysis only through 2023/24. Once these data become available, we can extend the simulated effects through 2024/25.

<sup>6</sup> See the earlier discussion of activities categorized as domestic promotion and those categorized as export promotion.



**Table 4: U.S. Pecan Industry Lift from Domestic and Export Pecan Promotion, 2020/21-2023/24**

	Changes from Domestic Promotion		Changes from Export Promotion		Total Change from Promotion	
	change	% change	change	% change	change	% change
<b>U.S. Pecan Supply (mil. lb)</b>						
Utilized Production (shelled)						
Native/Seedling	0.3	0.6	0.5	1.0	0.9	1.6
Improved Varieties	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.3	0.0	0.5	0.0	0.9	0.0
Imports (shelled)	14.9	3.1	5.8	1.2		
<b>U.S. Pecan Use (shelled) (mil. lb)</b>						
Domestic Use	29.4	3.9	-4.6	-0.6	24.8	3.2
Exports	-15.3	-4.3	10.2	3.0	-5.1	-1.5
Change in Stocks	1.2	2.9	0.7	1.4	1.9	2.2
<b>U.S. Pecan Prices (cents/lb)</b>						
Producer Prices (in-shell)						
Native/Seedling	10.6	10.7	4.1	3.8	14.7	13.5
Improved Varieties	16.9	10.3	6.6	3.7	23.5	13.0
U.S. Weighted Average	16.6	10.4	6.8	3.8	23.4	13.2
Export Price (shelled)	28.7	6.9	11.3	2.5	40.0	9.0
Import Price (shelled)	18.5	4.7	7.2	1.7	25.7	6.2
<b>Revenue/Profit (\$ million)</b>						
Export Revenue	37.6	2.6	82.8	5.6	120.4	8.1
Producer Revenue (Profit)	202.2	10.9	80.3	3.9	282.5	13.7

Note: “Lift” is the addition to pecan production, use, revenues, and producer profit as a result of promotion. Totals may not add due to rounding.

respectively. On the other hand, export promotion provided a 3.0% pecan export lift of 10.2 million pounds (shelled basis) partly by re-directing 4.6 million pounds (shelled basis) (0.6%) from the domestic market to exports.

On net, the more generously funded domestic promotion program prevailed resulting in a net lift in U.S. pecan use of 24.8 million pounds (shelled basis) (3.2%) and a net negative lift in exports of 5.1 million pounds (-1.5%). Together, the two programs provided a lift to pecan producer profit over the period of 2020/21 to 2023/24 of \$282.5 million (13.7%), including a \$202.2 million lift from domestic promotion and another \$80.3 million from export promotion. Additionally, taken together, the two programs provided a lift to export revenue too over the period 2020/21 to 2023/24 on the order of \$120.4 million (8.1%).

### Benefit-Cost Analysis of the Pecan Promotion Program

Clearly, based on the simulation analysis results summarized in Table 4, pecan marketing and promotion expenditures have effectively boosted pecan prices and pecan producer profit over



the period 2020/21 to 2023/24. A critical concern, of course, is whether the lift (gains) in producer profit induced by those promotion expenditures have been substantial enough over this period to more than cover the cost of the promotion to producers who pay for the promotion. If not, then the conclusion would be that the marketing and promotion programs should be discontinued because their cost is greater than the return to growers, shellers, and importers. On the other hand, if the producer profit generated by promotion more than covers the costs, the promotion program would be deemed a successful investment opportunity for pecan producers. This section provides a benefit-cost analysis of domestic and export promotion expenditures over the period 2020/21 to 2023/24 to answer these questions based on the simulation results.

Using equation (4) from the methodology section, we calculated the net revenue (profit) benefit-cost ratio (SBCR) for the domestic, export, and overall promotion programs over the period of 2020/21 through 2023/24. Recall that a BCR that is greater than 1 is interpreted as meaning that the program has more than paid for itself. Otherwise, the program has created an economic loss for pecan producers because the benefit generated is less than the program cost.

As exhibited in Table 5, with the lift in producer profit (net of the promotion cost) from domestic promotion and export promotion of \$189.4 million and \$74.4 million respectively, the total profit earned by pecan producers because of both domestic and export promotion over the period 2020/21 through 2023/24 amounted to \$263.8 million. Given that marketing and promotion expenditures over that same period totaled \$18.7 million, the BCR to the overall pecan promotion expenditures over the study period is 14.1. In other words, every dollar spent of domestic and international marketing and promotion returned \$14.1.

This BCR is well within the range of those reported for other generic commodity promotion programs and above the weighted average across many generic commodity promotion programs of nearly 7 to 1 as reported by Williams, Capps, and Hanselka (2018). They also report, however, that the BCRs of the newer, less well funded programs are generally above the average, ranging from about 10.0 to 28.0, while the BCRs of the better-funded and more well-established programs are generally below the average BCR. They conclude that as the level of expenditures by a commodity checkoff organization increases, the promotion BCR is expected to drop to some extent because the increase in producer profit generated for every additional dollar spent declines as promotion expenditures increase, a phenomenon known as the *law of diminishing returns*.

Thus, over time, if marketing and promotion expenditures for pecans continue to increase, the BCR would be expected to decline to some extent. The relatively high pecan promotion BCR also means that the current pecan promotion program likely is underfunded. Note that for every dollar in additional assessment NOT paid by pecan producers and invested in promotion, pecan producers lose an average of \$14.1 in additional profit. Further increases in the assessment might also lead to some reduction in the BCR because of the law of diminishing returns. However, with such a high estimated BCR, pecan producers could authorize a substantial increase in the assessment rate and still expect to generate a very reasonable rate of return and substantially higher profits. Interestingly, despite the lower level of producer profit generated from export promotion (\$74.4 million) compared to the domestic promotion program (\$189.4 million) as shown in Table 5, the BCR to the export promotion program of 12.6 is only slightly lower than the BCR for the domestic promotion program of 14.8.

**Table 5: Benefit-Cost Analysis of the Pecan Promotion Program, 2020/21 to 2023/24**

	<b>Domestic Promotion</b>	<b>Export Promotion</b>	<b>Total</b>
<b>Pecan Promotion Expenditures</b>	12.8	5.9	18.7
<b>Additional Producer Revenue (Profit) Earned (\$ million)</b>			
Gross Revenue (Profit)	202.2	80.3	282.4
Net Revenue (Profit)	189.4	74.4	263.8
<b>Producer Net Benefit-Cost Ratio (BCR)</b>	<b>14.8</b>	<b>12.6</b>	<b>14.1</b>

### **Economic Contribution Analysis Associated with the Pecan Checkoff Program**

The general methodology employed is referred to as “economic contribution analysis” and is based on the idea that a dollar spent stimulates additional economic activity through the U.S. economy. To estimate the national-level economic contribution of the incremental revenues from the pecan checkoff program through the supply chain, we use the well-known, widely used, and well documented IMPLAN (IMPact analysis for PLANning) input-output system (IMPLAN Model, 2022). Input-output analysis is based on the idea that a change in one sector of the economy has effects on other sectors (the multiplier effect). Input-output analysis captures the relationships among industries and estimates the change in each sector’s sales due to an initial change in final demand for a given industry’s output. The sum of these changes is the industry’s multiplier. In this study, we analyze the contribution of the incremental revenue from the pecan checkoff program (\$263.8 million as discussed previously) to the value of U.S. national output, value-added, employment, and labor income.

In general, four types of economic effects are reported from IMPLAN analyses. The *employment* contribution measures the number of jobs (both full-time and part-time) attributable to the direct economic activity stimulated. The contribution to *labor income* measures the effect of spending by businesses on the incomes of households. The *value-added* measures dollar value added to U.S. gross domestic product (GDP). The *output* contribution measures economic activity (total spending) generated. Labor income is a subset of value-added which is part of output.

#### *Procedures Followed in the National Aggregate Analysis*

The national economic contribution analysis of pecan incremental revenues specifically for the period 2020/2021, 2021/2022, 2022/2023, and 2023/2024. The IMPLAN software was used to write component information, add structural matrices, create regional absorption tables, commodity balances, market shares, and international transfers, and compute and create multipliers for the U.S. model (IMPLAN Model, 2024, Application and Data).

The next step was to determine the IMPLAN sector to use for the analysis of the economic contribution of the pecan checkoff program. IMPLAN consists of 546 different sectors from production to transportation, wholesale, manufacturing, retail, services and others. For this analysis, the sector labeled as tree nuts was used. This industry sector best reflects the direct impact that incremental revenues from the pecan checkoff program would have on the U.S economy.



**Table 6: National Economic Impact of Incremental Revenues Generated from the Pecan Checkoff Program**

<b>Output</b> (\$ million)	<b>Value-added</b> (\$ million)	<b>Employment</b> (no. of jobs)	<b>Labor Income</b> (\$ million)	<b>Taxes*</b> (\$ million)
\$544.4	\$426.2	849	\$274.8	\$86.9

\*Federal, state, local taxes.

### *National Aggregate Analysis Results*

IMPLAN calculates the direct, indirect, induced, and total effects for output (total spending), employment (full-time and part-time jobs), value added (contribution to GDP), and labor income (employee compensation). This analysis demonstrates that pecan checkoff program revenues have made a modest contribution to the U.S. economy. With the disbursement of \$18.7 million on domestic and export promotion, the cumulative net revenue to pecan producers was \$263.76 million, after netting out the cost of the promotion programs (\$81.35 million for 2020/21, \$81.82 million for 2021/22, \$57.04 million for 2022/23, and \$43.55 million for 2023/24).

In turn, this incremental net revenue based on the IMPLAN analysis led to spillovers or multiplier effects for the general economy. As exhibited in Table 6, the total of all the direct, indirect, and induced effects of the \$263.76 million of U.S. pecan checkoff program incremental revenues for the period 2020/21 to 2023/24 on total spending amounted to \$544.4 million. That is, the \$263.76 million of producer revenues stimulated U.S. economic activity that generated a total of \$544.4 million in national output or total spending. At the same time, the total economic activity stimulated by those incremental producer revenues added nearly \$426.2 million to domestic GDP, created \$274.8 million in U.S. labor income, generated \$86.9 million in taxes (federal, state, and local), and added 849 part-time and full-time jobs.



## CONCLUSIONS AND IMPLICATIONS

Unequivocally, rightward shifts in the domestic demand for pecans, the export demand for pecans, and the import demands of pecans in the United Kingdom, China, the Netherlands, and India were evident because of the checkoff program. A principal accomplishment of the domestic and export marketing and promotion activities has been to support the annual average producer price of pecans about 23¢ per pound above the level it would have been had these efforts not been made over the period of 2020/21 through 2023/24. With higher prices than would have occurred without the promotion on about the same level of production, pecan producer profit was also higher than it might have been without the promotion by a total of about \$282.5 million over the study period. As such, the benefit-cost ratio associated with marketing and promotion expenditures over 2020/21 through 2023/24 was calculated to be 14.1. The primary conclusion from this analysis is that the generic domestic and international marketing efforts associated with the pecan checkoff program over the period 2020/21 through 2023/24 generated a return-on-investment of roughly 14 to 1 to industry stakeholders who paid for the program. In the previous report, the return-on-investment for the period 2016/17 through 2019/20 was calculated at nearly 10 to 1. Simply put, the ROI to marketing and promotion activities has been sustained since the initial study was conducted in January 2021.

Further, domestic and export promotion of pecans provided a lift to pecan producer profit over the period of 2020/21 to 2023/24 by \$282.5 million (13.7%), including a \$202.2 million lift from domestic promotion and another \$80.3 million from export promotion. After accounting for the cost of the promotion programs--\$12.8 million for domestic promotion and \$5.9 million for export promotion, the net BCR for domestic promotion was calculated to be 14.8 to 1, while the net BCR associated with export promotion was calculated to be 12.6 to 1.

Of note, this analysis also demonstrates that pecan checkoff program revenues have made a modest contribution to the U.S. economy. With the disbursement of \$18.7 million on domestic and export promotion, the cumulative net revenue to pecan growers was \$263.76 million, after netting out the cost of the promotion programs (\$81.35 million for 2020/21, \$81.82 million for 2021/22, \$57.04 million for 2022/23, and \$43.55 million for 2023/24). In turn, this incremental net revenue based on input-output analysis (IMPLAN analysis) led to spillovers or multiplier effects for the general economy. The total of all the direct, indirect, and induced effects of the \$263.76 million of U.S. pecan checkoff program incremental revenues for the period 2020/21 to 2023/24 subsequently generated \$544.4 million in additional national output or total spending, added \$426.2 million to domestic GDP, created \$274.8 million in U.S. labor income, generated \$86.9 million in taxes (federal, state, and local), and added 849 part-time and full-time jobs.

This analysis and assessment leads to several important implications for management. First, the magnitude of the BCR or ROI for pecan promotion expenditures in this study is greater than the BCRs calculated for programs like soybeans, cotton, beef, and pork. The relatively high BCR primarily reflects the smaller size of pecan promotion expenditures compared to those of other major commodities, many of which spend in excess of \$100 million per year on promotion. Not only is the average amount spent each year since its inception quite small in comparison to that of larger generic commodity promotion programs, the pecan promotion intensity, that is, the ratio of pecan promotion expenditures to the value of pecan production, was only 0.2% on average over the 2020/21 through 2023/24 period, compared to generally about 2% for the larger programs. In other words, stakeholders in the larger generic commodity promotion programs pay more and



contribute a generally higher share of their industry revenues to their respective commodity promotion programs than do pecan growers, shellers, and importers.

Second, a key implication that follows from the previous point is that the pecan promotion program likely is underfunded which imposes a notable opportunity cost on pecan producers of potentially millions of dollars. The results indicate that for every dollar in additional assessment NOT paid by pecan producers and, thus, not spent on pecan promotion, producers lose an average of \$14.1 in additional profit. Of course, as previously noted, increases in checkoff assessment rates and total spending on promotion are usually accompanied by reductions in the corresponding BCR. But with this calculated BCR of 14.1 to 1, producers could profitably afford to increase the assessment rate materially beyond current levels and still expect to generate a very reasonable rate of return comparable to the \$2 to \$6 per dollar of promotion earned by the beef, pork, cotton, soybeans, and other enterprises associated with the larger commodity promotion programs.

Third, the sizable BCR calculated for the pecan promotion program by itself is not indicative of the level of impact of the program on the U.S. pecan industry. The BCR indicates only the return generated from the investment and not the level of impact that promotion had on pecan production, utilization, exports, price, or producer revenue. Because the BCR as a measure of effectiveness is often misunderstood, perhaps the best metrics are the impacts of domestic and export promotion on key industry measures. In the case of pecans, we determine through sophisticated econometric analysis and simulation that pecan promotion expenditures can take credit for supporting domestic utilization by 3.2%, weighted average grower prices of pecans by 13.2%, export prices by 9%, export revenue by 8.1%, and enhancing producer profit by \$282.4 million by 13.7% (not accounting for the cost of the assessments to producers). This gain in profits of close to \$300 million would not have been earned by producers without the efforts in promotion, a remarkable achievement with a modest budget over a short period of time from 2020/21 to 2023/24.



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