Return on Investment in the American Lamb Checkoff Program

2024 UPDATE

Report to the American Lamb Board

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ABSTRACT

This study is an updated evaluation of the return on investment in the American Lamb Checkoff Program as required by legislation. The salient finding is that between 1.7% and 1.9% of the annual average retail value of U.S. lamb consumption between 2003/04 and 2022/23 is the direct result of the promotion efforts of the American Lamb Board from increasing both the price and quantity of lamb consumed. The result was a high return to the lamb industry over that period of $16.6 in additional industry profit -per dollar invested in promotion.

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The research reported here was conducted under contract with the American Lamb Board (ALB). The lamb advertising and promotion data used in this study were provided by ALB but all other data were collected independently by the authors. ALB did not attempt to influence the wording or conclusions of this report. The conclusions reached and any views expressed are those of the authors and may not represent those of ALB or Texas A&M University.

RETURN ON INVESTMENT IN THE AMERICAN LAMB CHECKOFF PROGRAM

2024 UPDATE

EXECUTIVE SUMMARY

This report is the 2024 evaluation update of the return on investment (ROI) in the American Lamb Checkoff Program as mandated under the terms of the Lamb Promotion, Research, and Information Order established under the Commodity Promotion, Research and Information Act of 1996. This updated evaluation covers the period of 2003/04 through 2022/23, adding five years of data to the analysis compared to the previous report. The primary objectives are to determine: (1) the effects of the American Lamb Checkoff Program on U.S. lamb markets and (2) the returns to the U.S. lamb industry from its investment in the checkoff program (the ROI). For the analysis, an econometric simulation model of the U.S. lamb industry was developed that measures not only the effects of the lamb checkoff promotion on U.S. lamb demand but also on U.S. lamb production, imports, and prices. The results are used in a benefit-cost analysis to determine the return on the investment by the U.S. lamb industry in the lamb checkoff program.

Key findings for the updated evaluation of ALB promotion covering the 2003/04 through 2022/23 period of analysis include the following:

Effects of the American Lamb Checkoff Program on U.S. Lamb Markets

- With modest funds available for promotion, the ALB has succeeded in substantially enhancing the annual value of U.S. lamb consumed by a total of between $1.17 billion (1.7%) to $1.31 billion (1.9%) over the period of analysis.
- The increase in the consumption value was the result of both a higher level of lamb consumption due to ALB promotion by an annual average of 1.0% to 1.3% that pushed up the retail lamb price by annual average of 0.3% to 1.0%.
- The higher price during that period stimulated a higher level of both U.S. lamb production by about 1% to 2.3% and lamb imports by a smaller 0.5% to 1.4% which muted the price response to the promotion somewhat.
- The market effects were somewhat smaller than those found in the previous evaluation primarily due to the COVID-reduced levels of total promotion spending over the 2018/19-2022/23 period of the analysis.

Returns to the U.S. Lamb Industry

- The benefit-cost ratio (BCR) from ALB promotion in terms of additional industry profit was determined to be $16.6 per promotion dollar over the period of analysis.

- The BCR is somewhat higher than the $14.2 per promotion dollar found in the previous evaluation, primarily due to various factors including the carryover of lamb promotion in previous years on consumer behavior into the 2018/19-2022/23 period when promotion expenditures declined.

Important implications of the analysis for consideration include the following:

- *The most meaningful metric of program effectiveness in enhancing lamb demand is the range of $1.17 billion (1.7%) to $ 1.31 billion (1.9%) of the value of lamb sales (consumption) that has been added by lamb promotion over the life of the program.*

  The message that ALB has added from $1.17 billion (1.7%) to $1.31 billion (1.9%) to the total value of lamb consumption over the lifetime of the program is powerful given that lamb checkoff expenditures have amounted to only about 0.04% of the total value of consumption over that period. This metric of impact is more understandable and more believable than a high BCR which is often misunderstood to imply unreasonably high market impact. The share of the value of lamb sales that ALB can take credit for may help stakeholders understand what they are getting for their checkoff dollars.

- *The high BCR for the lamb checkoff program is not indicative of the level of impact of the program on the U.S. lamb industry.*

  The small amount of lamb checkoff funds expended in each year generated a positive but rather small lift for the industry. The small positive benefit divided by an even smaller checkoff expenditure resulted in a relatively large BCR. However, a BCR of 16.6:1 results from dividing a $16.6 billion industry profit benefit by a $1 billion checkoff investment or from dividing only a $16.6 benefit by a $1 investment. Thus, the BCR indicates only the return generated from the investment and not the level of impact the program has on lamb demand or price.

- *The highly positive BCR calculated for the lamb checkoff program in this study also does not indicate that the lamb checkoff program is more effective than the larger checkoff programs which tend to have smaller estimated BCRs.*

  Research has shown that as the level of checkoff promotion expenditures increases, the return from larger investments increases but at a slower rate. Thus, calculated BCRs for large checkoff programs, such as dairy, soybeans, and cotton, tend to be much smaller than for smaller checkoff programs. The larger checkoff programs collect and invest much in excess of $100 million in promotion so their market impacts are understandably larger.

- *Despite the increase in the lamb checkoff assessment that was passed in 2013, the program continues to be vastly underfunded imposing a huge opportunity cost on industry stakeholders of potentially millions of dollars.*

  The high BCR of $16.6 means that for every dollar in additional assessment NOT paid by stakeholders and spent on lamb promotion, industry stakeholders lose an average of $16.6 in potential additional industry revenue. Further increases in the assessment would lead to some reduction in the BCR. However, with such a high estimated BCR, the lamb industry could substantially increase the assessment rate and still expect to generate a high rate of return.

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RETURN ON INVESTMENT IN THE AMERICAN LAMB CHECKOFF PROGRAM

2024 UPDATE

This study is an update of the last 5-year evaluation of the return on investment (ROI) in the American Lamb Checkoff Program (Williams and Hanselka, 2018) as mandated under the terms of the Lamb Promotion, Research, and Information Order, better known as the American Lamb Checkoff Program, established under the Commodity Promotion, Research and Information Act of 1996. This updated evaluation covers the period of 2003/04 through 2022/23, adding five years of data to the analysis compared to the previous report. The primary objectives are to determine: (1) the effects of the American Lamb Checkoff Program on U.S. lamb markets and (2) the returns to the U.S. lamb industry from its investment in the checkoff program (the ROI). For the analysis, an econometric simulation model of the U.S. lamb industry was developed that measures not only the effects of the lamb checkoff promotion on U.S. lamb demand but also on U.S. lamb production, imports, and prices. The results are used in a benefit-cost analysis to determine the return on the investment by the U.S. lamb industry in the lamb checkoff program.

The report begins with some background on the American Lamb Checkoff Program. A discussion of the methodologies employed in the analysis is followed by the results of employing those methodologies to achieve the study objectives. The report ends with concluding comments and implications for the lamb checkoff program.

THE AMERICAN LAMB CHECKOFF PROGRAM

Modest industry-financed programs to promote the consumption of U.S. lamb have operated in most years since at least the late 1970s. Beginning in about 1978/79, the American Sheep Producers Council, now known as the American Sheep Industry Association (ASIA), operated a lamb promotion program with voluntary deductions from government payments to lamb producers and feeders under the Wool Incentive Program. The deductions were authorized by a producer referendum under section 708 of the 1954 National Wool Act. As seen in Figure 1, the annual nominal expenditures on lamb promotion activities grew from $1.2 million in 1978/79 to a high of $3 million in 1993 before declining to $1.2 in 1996/97 as the phase-out of the Wool Incentive Program began to take effect[1].

[1] More detail on lamb promotion programs and activities prior to the establishment of the current lamb checkoff program under the American Lamb Board are provided in the previous return on investment report (Williams and Hanselka, 2018).

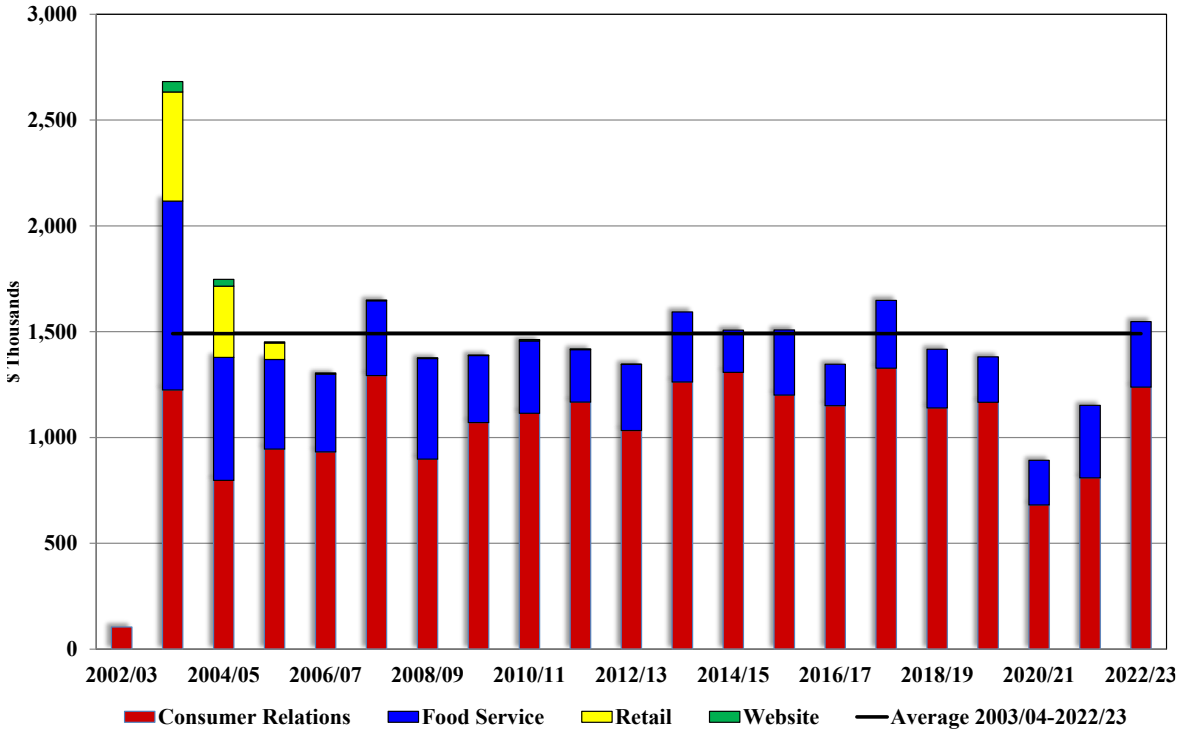
With the termination of the Wool Incentive Program in 1996/97, an unsuccessful industry effort was made that year to pass a mandatory checkoff program through a producer referendum. At the about same time, the U.S. lamb industry filed a section 201 complaint against Australia and New Zealand lamb imports which resulted in the imposition of a three-year tariff-rate quota (TRQ) beginning in 1999 on lamb imports from Australia and New Zealand. The revenue collected from the tariff was given to the domestic lamb industry in an assistance package of $4.8 million that funded 23 lamb marketing and promotion projects in 2000/2001 and 2001/2002.

The current lamb checkoff program was initiated in 2002 following another producer referendum. Since 2003/04 (the first effective year of expenditures) through 2022/23 (July/June), the American Lamb Board (ALB), charged with the use and management of lamb checkoff funds, has spent a total of just over $29.8 million on lamb promotion, an average of about $1.49 million per lamb marketing year (Figure 1). Except for the COVID years of 2020/21 and 2021/22, the trend in spending has been flat ranging over the non-COVID years from a high a $2.68 million in 2003/04 to a low of $1.30 million in 2006/07. In the first year of COVID (2020/21), spending dropped to just under $893,000 and increased somewhat the following year to about $1.2 million. In 2022/23, promotion spending jumped to $1.55 million, the highest level since 2013/14 ($1.59 million) and the second highest level since 2007/08 ($1.65 million).

Since its inception, ALB has concentrated its promotion spending on two focus areas: (1) consumer communications/relations including a wide variety of tasks and publicity efforts to promote directly to current and potential lamb consumers and users (newsletters, news releases, photography, websites, and other media/promotional support, etc. and (2) food service promotion, including the development and placement of advertising with food service establishments, exhibits at culinary promotional events, etc. For every dollar spent on food service promotion, ALB has spent $3.1 on consumer relations promotion. Thus, spending on consumer relations has averaged 73% of total promotion spending while food service averaged about 23% of the total over 2003/04 – 2022/23 period. The other 4% was spent primarily on retail food store promotion in the early program years. By law, ALB administrative expenditures are limited to no more than 10% of projected total revenues each year. No funds can be used for lobbying or influencing government policy. The U.S Department of Agriculture (USDA) oversees the operation of the program.

The main objectives of the Lamb Checkoff Program under ALB have been to build demand for American Lamb and to recapture market share from imports (American Lamb Board, 2023). The program is funded by an assessment on all feeder and market lambs and all breeding stock and cull animals. In general, the purchaser collects the assessment with a deduction from the sales proceeds of the seller. The funds are then carried forward to the point of slaughter or export market and then collected and sent to the Board. Those who are assessed include producers (including seedstock producers), exporters, feeders and direct marketers, and slaughter plants (including ethnic and custom slaughter operations). The small number of imported sheep and lambs are also assessed on

Figure 1: Lamb Promotion Expenditures by Category, 2002/03 – 2022/23 (July/June)



weight gain. U.S. lamb imports are not subject to the assessment. From the beginning of the checkoff through May 2013, the assessment was $0.005 per pound of ovine animals (any age) sold by producers, exporters, and feeders and $0.30 per head of lambs purchased for slaughter by first handlers. Marketing agencies are not assessed a checkoff fee but they must collect assessments from the sellers and pass them on to the purchasers. Direct marketers who are both producers and first handlers were required to pay the $0.005 per pound assessment on the live weight at the time of slaughter and also the $0.30 per head assessment. In June 2013, the per-pound assessment on live sheep and lambs sold (the "live weight assessment") increased to $0.007 while the first handler assessment (or 'per head assessment") increased to $0.42 per head. A "first handler" is defined as the owner of the animal at time of slaughter, such as packer, processor, or direct marketer.

Compared to the value of U.S. lamb consumed each year, the amount of funds that the lamb checkoff program spends for the promotion of lamb is extremely small. The annual lamb advertising-to-sales ratio (often referred to as the checkoff investment intensity ratio) was only 0.043% over the 2003/04 – 2022/23 period. In other words, for every $100 in retail revenue from lamb over that period, only about 4.3 cents were spent to promote lamb consumption. The lamb advertising intensity has been lower since the establishment of the current checkoff program than in earlier years because fewer promotion funds have been made available through the current program than what was formerly spent on lamb promotion by the ASIA under the Wool Incentive Program (see Williams and Hanselka, 2018).

STUDY METHODOLOGY

In this 2024 update of the American Lamb Checkoff Program analysis, we utilize the model of the U.S. lamb industry developed and discussed in the previous study of the lamb checkoff program (Williams and Hanselka, 2018). In this analysis, however, we update the econometric analysis of U.S. lamb demand equation of the model. The lamb demand equation as a component of the U.S. lamb industry model developed for the previous analysis and updated and used in this analysis is first discussed in this section. The process of using the U.S. lamb industry model in a counter-factual simulation analysis to determine the lamb market impacts of promotion is then discussed. Finally, the process of using the simulation results to calculate the benefit-cost ratio (BCR) for lamb promotion, the most common ROI measure, is then laid out.

The U.S. Lamb Industry Model

The U.S. lamb industry can be represented as an economic model with the following six equations[2]:

(1) $S_L = S_L(P_L, \alpha_L)$
(2) $D_L = D_L(P_L, \beta_{L,} \beta_O)$
(3) $M_L = D_L - S_L$
(4) $P_L = P_L(P_F, \theta_F)$,
(5) $ES_L = ES_L(P_F, \alpha_{ES})$
(6) $M_L = ES_L$

where the endogenous variables of the model are S_L (U.S. lamb supply), D_L (U.S. lamb demand), P_L (U.S. retail price of lamb), M_L (U.S. lamb imports), ES_L (the foreign supply of lamb to the U.S.), and P_F (import price of lamb). The terms α_L, β_L, β_O, θ_F, and α_{ES} are exogenous shift variables. The α_L shift variable in the lamb supply equation (1) accounts for technology, disease, and other forces that impact the U.S. production of lamb. The shift variable β_L in the lamb demand equation (2) represents lamb industry expenditures over the years to promote the consumption of U.S. lamb. The shift variable β_O in that same equation represents market forces other than the price of lamb and promotion expenditures that influence the demand for lamb such as consumer income, prices of other meats (beef, pork, chicken), inflation, and population. The shift variable θ_F represents international market forces that affect the difference between the U.S. retail price of lamb (P_L) and the import price of lamb (P_F) such and the exchange rate, transportation costs, etc. The shift variable α_{ES} represents the market forces other than price that affect the supply of lamb exports from Australia and New Zealand.

[2] See Williams and Hanselka (2018) for a complete discussion of the model of the U.S. lamb industry as developed and used for this analysis.

The model is used in a counter-factual simulation analysis of the *changes* in U.S. lamb production (S_L), demand (D_L), price (P_L), and imports (M_L) from a *change* in the level of promotion expenditures (β_L). Several key parameters from the model are required for the subsequent counterfactual simulation analysis, including:

(a) The slope of the lamb supply curve $(\frac{\partial S_L}{\partial P_L})$ from equation (1) from which is calculated the price elasticity of lamb supply ($\frac{\partial S_L}{\partial P_L}\frac{P_L}{S_L}$);

(b) The slope of the lamb demand curve $(\frac{\partial D_L}{\partial P_L})$ from equation (2) from which is calculated the price elasticity of lamb demand ($\frac{\partial D_L}{\partial P_L}\frac{P_L}{D_L}$);

(c) The slope of the lamb import supply curve $(\frac{\partial ES_F}{\partial P_F})$ from equation (5) from which is calculated the price elasticity of lamb import supply ($\frac{\partial ES_F}{\partial P_F}\frac{P_F}{D_F}$); and

(d) The slope of the lamb demand with respect to promotion $(\frac{\partial D_L}{\partial \beta_L})$ from equation (2) from which is calculated from the lamb demand promotion elasticity ($\frac{\partial D_L}{\partial \beta_L}\frac{\beta_L}{D_L}$).

Estimating the Parameters of the Lamb Demand Equation

To econometrically estimate the parameters of the lamb demand equation (2) and calculate the critical lamb demand elasticities for the counterfactual simulation analysis with respect to price and lamb promotion expenditures ((b and (d) above), equation (2) is operationalized as follows in which the L subscript for lamb is dropped:

(7) $D_t/POP_t = D_t(P_t/I_t, P_{it}/I_t, Y_t/POP_t/I_t, G_t,)$

where D = total U.S. lamb consumption; P = nominal retail price of lamb; P_i = nominal retail price of alternative meat i where i = beef, pork, and chicken; Y = personal disposable income; I = consumer price index; POP is the U.S; population; G_t is a "goodwill" stock of lamb promotion funding expenditures; and t = the current year.

The long history of analysis of generic advertising and promotion programs has demonstrated rather conclusively that such promotion programs have carryover effects. That is, expenditures in a given year do not have their full effect on demand in the period of expenditure but rather the effects are distributed over a number of periods. Thus, some form of distributed lag structure is necessary to capture these effects such as the goodwill stock of lamb promotion expenditures (G) in equation (14). The goodwill variable (G) is constructed as:

(8) $$G_t = \sum_{i=0}^{m} w_i f[\beta_{L\,t-i}]$$

where $\beta_{L\,t-i}$ refers to current and lagged lamb promotion expenditures for i = 0, 1, …, m, w_i are lag weights, and f corresponds to a natural logarithmic transformation to account for the diminishing returns to promotion expenditures. The promotion expenditures (β_L) in equation (8) must be deflated to properly account for the actual purchasing power of the promotion expenditures over time. The resulting structure of G in the lamb demand equation (8) 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, Ghosh and Williams, 2016, and Williams and Hanselka, 2018). Theory provides relatively little guidance as to the structure and length of these dynamic processes. Conventionally, researchers, through the use of statistical criteria like the Akaike Information Criterion (AIC) or the Schwarz Loss Criterion (SLC), allow the data to suggest the optimal number of lags (the subscript i in equation (8)) to include in the specification.

The use of the PDL formulation eliminates collinearity among the lagged promotion variables and saves degrees of freedom since only one parameter must be estimated. The PDL structure reveals the nature of the effect of the promotion expenditures on U.S. lamb demand. The search for the pattern and time period over which lamb advertising and promotion affect U.S. lamb demand involved a series of nested OLS regressions. For each lag formulation, lags of up to four years were considered and for the PDL, up to fourth degree polynomials with alternative choices of head and tail restrictions. Based on the Akaike Information Criterion (AIC), the Schwarz statistic, and the Hannan-Quinn criterion, a second order PDL of lag length of two years with endpoint constraints was selected.

Other Model Parameters

The slope (price elasticity) of lamb import supply from equation (5) in the model (the parameter indicated in (c) above) can be calculated from the work of Ghosh and Williams (2016). Alternatively, a range of plausible assumed elasticities can be used. For the slope (price elasticity) of U.S. lamb supply from equation (1) (the parameter indicated in (a) above), a range of plausible elasticities is also used. The result is a range of plausible effects of lamb promotion on lamb demand (D_L), lamb supply, (S_L), lamb price (P_L), and lamb imports (M_L). The use of these parameters for the counter-factual simulation is discussed in more detail later.

Counter-Factual Simulation Analysis Process

The first objective of this study is to determine the effects of the American Lamb Checkoff Program on U.S. lamb markets and imports. For the analysis, we use the U.S. lamb industry model as represented in equations (1) through (6) to conduct a counterfactual simulation analysis of the

effectiveness of the lamb checkoff program over 2003/04 through 2022/23. In a counter-factual simulation analysis, two scenarios are simulated: (1) a "*with promotion"* scenario or the baseline scenario and (2) a "*without promotion"* scenario. The *with promotion* scenario is the level of lamb production, demand, price, and imports that actually existed over history because this scenario assumes that the checkoff promotion expenditures to enhance U.S. lamb demand were made as actually occurred in 2003/04 through 2022/23. The *without promotion* scenario assumes that the checkoff promotion expenditures were not made as actually occurred over that time period. In other words, the counter-factual simulation assumes that the lamb checkoff program never existed. To conduct the *without promotion* counter-factual scenario, lamb checkoff promotion expenditures are set to zero in every year in the lamb demand equation of the U.S. lamb industry model and the consequent levels of lamb production, demand, price, and imports are calculated. The simulation produces levels of U.S. lamb production, demand, price, and imports that would have existed if there had not been any expenditures over time to promote lamb demand. The differences between the levels of lamb production, demand, price, and imports in 2003/04 -2022/23 in the two scenarios provide a measure of the change not only in U.S. lamb demand but also in all other model variables that have occurred over that period as a direct result of the lamb checkoff promotion expenditures.

The price and quantity effects in the counter-factual simulation depend critically on several parameters in the model, as discussed earlier, including: (1) the responsiveness of the lamb supply to price changes (that is, price elasticity of lamb supply), (2) the responsiveness of lamb demand to price changes (that is, the price elasticity of lamb demand), (3) the price responsiveness of the foreign export supply of lamb to the United States (that is, the lamb import supply price elasticity), (4) the responsiveness of lamb demand to promotion expenditures (that is, the lamb demand promotion elasticity), and (5) the level of promotion expenditures.

The price and promotion elasticities of lamb demand (the parameters listed in (2) and (4) above) were derived through econometric estimation of U.S. lamb demand (discussed in detail in the next section). The change in promotion (the parameter referred to in (5) above) is the level of promotion expenditures in each year between 2003/04 and 2022/23.

For the lamb supply elasticity (the parameter listed (1)), a range of plausible elasticities are used in the simulation analysis to determine a reasonable, plausible range of effects of promotion on the market. Only a few studies have estimated a price elasticity of the U.S. supply of lamb. Ghosh (2014) reports a long-run price elasticity of U.S. lamb supply of 5.1 which is about the mid-point of the range of 0.01 over a one-year time horizon to 11.38 over a 30-year time period estimated by Whipple and Menkhaus (1989). The International Trade Commission (1995) assumed a range of 1.0 to 2.8 for the price elasticity of U.S. lamb supply in their analysis of U.S. lamb import policy. Consequently, a range of 1.0 to 5.0 seems reasonable to use for the lower and upper bounds of the long-run price elasticity of the U.S. lamb supply for the counter-factual simulation analysis.

For the parameter corresponding to the price elasticity of the supply of U.S. lamb imports (or, in other words, the supply of exports to the U.S. market from foreign sources), few studies provide any estimates. Several studies that have analyzed the Australian sheep industry have found a low price-responsiveness of Australian sheep supply to lamb price changes over the long-run (see, for example, Griffith et al., 2001; Fisher and Wall, 1990; and Ghosh 2014). The implication is a limited ability of any price changes in the Australian lamb export market to generate changes in Australian sheep production or, as a result, lamb production or lamb supplies for export. In other words, price changes in the Australian lamb market have limited ability to effect changes in the Australian supply of lamb available for export because sheep and lamb production are highly unresponsive to price changes. From the work of Ghosh (2014), we can calculate a long-run Australian/New Zealand lamb export supply elasticity of about 0.2 estimated over 1998-2011. That elasticity seems too low despite the low Australian and New Zealand sheep supply elasticities that Ghosh estimated. Consequently, for the counterfactual analysis, we posit a more plausible range for the price elasticity of the supply of Australia/New Zealand lamb imports into the U.S. with a lower bound of 1.0 and an upper bound of 2.0 which is lower than the upper bound assumed for the U.S. lamb supply elasticity to reflect the lower responsiveness of Australian lamb supply to price than is the case in the United States.

Given the assumed range of the U.S. lamb supply price elasticity of 1.0 to 5.0 over the long run and of 1.0 to 2.0 for the supply of lamb into the U.S. market from foreign suppliers, four separate simulations were conducted with four combinations of assumed price elasticities of U.S. lamb supply and import supply of foreign lamb into the U.S. (see Table 1). Simulation 1 assumes that both the U.S. and foreign import supply elasticities are at their upper bounds (highest plausible level) of 5.0 and 2.0, respectively. Simulation 2 continues to assume that the U.S. lamb supply elasticity is at its upper bound (5.0) but allows for a lower elasticity of foreign import supply at a lower bound of 1.0. Simulation 3 assumes that the U.S lamb supply elasticity is at its lower bound of 1.0 but that the elasticity of foreign export supply of lamb is at its upper bound of 2.0. The fourth simulation assumes that both elasticities are at their lower bounds of 1.0.

Benefit-Cost Analysis Process

The results of the counterfactual analysis are then used in a benefit-cost analysis to achieve the second objective of this study to determine the returns to the U.S. lamb industry from its investment in the checkoff program (the ROI). If the counter-factual analysis determines that there has been little or no impact of lamb promotion on lamb demand, then obviously the lamb industry has received little or no benefit from its investment in lamb promotion. If the analysis determines that promotion has indeed enhanced lamb demand, then the critical question is whether the gains realized by the lamb industry as a result of the promotion expenditures have been sufficient to more than pay for their costs in financing the promotion. That is, has the lamb promotion program

Table 1: Counterfactual "*Without Promotion*" Simulations Conducted

	Simulations with Alternative Elasticity Assumptions			
	1	**2**	**3**	**4**
Assumed Long-Run Elasticity of:	Both at Upper Bound (UB)	DS at UB and ES at LB	DS at LB and ES at UB	Both at Lower Bound (LB)
Domestic Lamb Supply (DS)	5.0	5.0	1.0	1.0
Foreign Lamb Export Supply (ES)	2.0	1.0	2.0	1.0

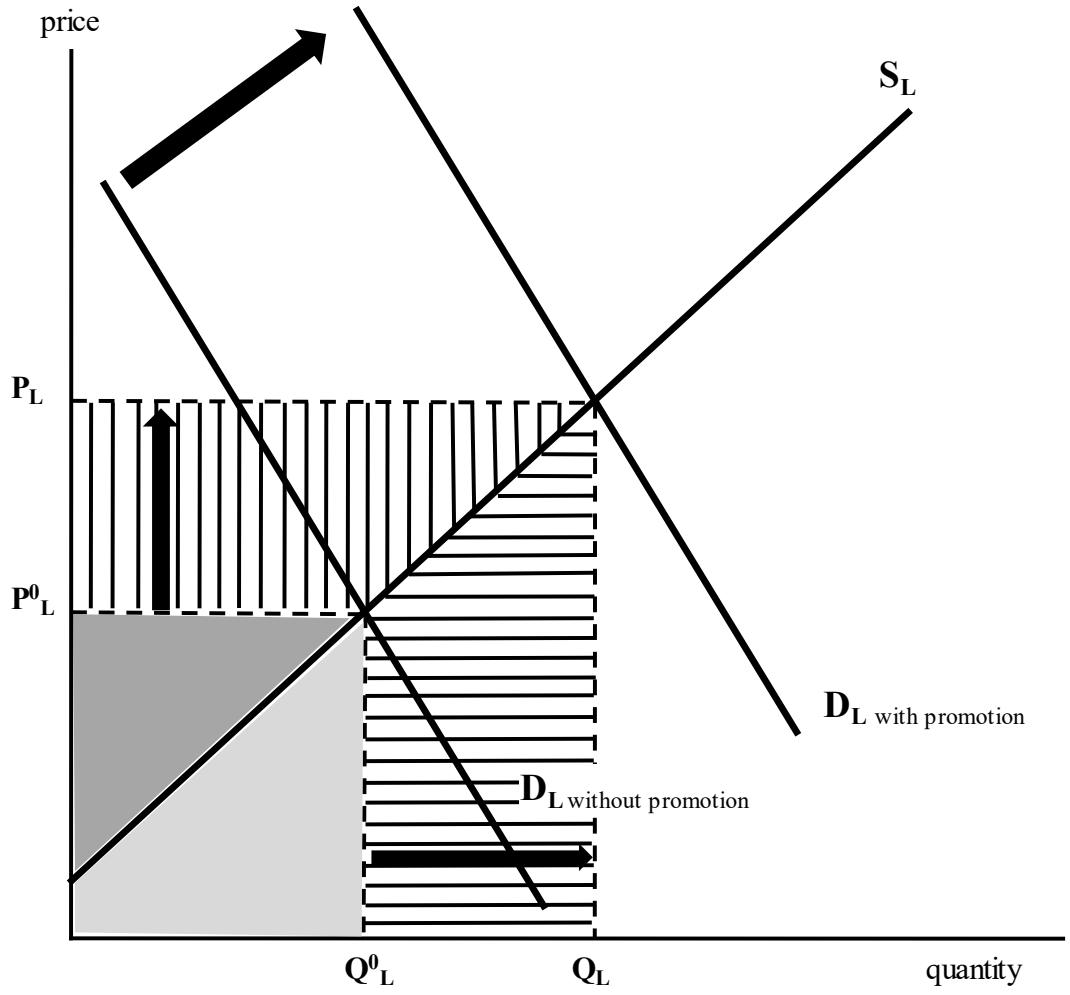
run at a loss or a profit over time from the perspective of the lamb industry that paid for the promotion? Have the market effects induced by promotion expenditures been substantial enough to generate sufficient additional returns to the industry over time to more than cover the cost to the industry in financing the promotion? If not, then the conclusion would be that the program should be discontinued because the program costs more than it benefits (returns) to the industry. On the other hand, if the returns generated more than cover the costs, the program would be deemed a successful investment opportunity for the lamb industry.

Figure 2 illustrates how the measures of benefit to cost from the lamb industry investments in lamb promotion are calculated from the results of the simulation analysis. The objective of demand promotion is to shift out the demand curve for lamb and, thereby, increase the market price on a higher volume of sales over time. Indeed, promotion programs that successfully move out the demand curve raise price. In raising the price, however, they also stimulate a greater level of production over time than would have occurred which moderates the extent of the price increase.

In Figure 2, lamb industry revenue before promotion occurs is measured as the sum of the dark and light gray areas (P^0_L x Q^0_L). The lamb supply curve (S_L) indicates the prices that lamb producers would be willing to accept for each additional unit of lamb production to just cover costs. Thus, the area under the supply curve up to Q^0_L where the demand curve ($D_{L\text{ without promotion}}$) crosses S_L, (the light gray area in Figure 2) is a measure of the minimum total amount exporters would be willing to accept for the Q^0_L level of lamb demanded in the market.

Of course, however, producers do not sell each additional quantity of their lamb supply at the exact price that would just cover their costs. Rather, they sell all units of their supply at the lamb market price of P^0_L (before promotion). Thus, the dark gray area in Figure 2 is the "surplus" revenue earned over and above the costs of producing that level of lamb supply before promotion. Although

Figure 2: Returns to the Lamb Industry from Lamb Demand Promotion



not precisely the same thing, the "surplus" (often referred to as the "economic surplus") gained can be thought of as a measure of lamb producers' profit from producing Q^0_L level of lamb supply.

Lamb promotion that shifts the lamb demand from $D_{L\ \text{without promotion}}$ to $D_{L\ \text{with promotion}}$ in Figure 2 raises the lamb price from P^0_L to P_L on a higher volume of lamb supply over time from Q^0_L to Q_L. The result is an <u>increase</u> in revenue to lamb producers represented in Figure 2 as the sum of the vertically and horizontally lined areas. The "return" to producers is the <u>additional</u> "economic surplus" or industry profit earned as a result (the vertically lined area only in Figure 2). If the additional profit earned as a result of the promotion is greater than the cost of shifting the demand curve from $D_{L\ \text{without promotion}}$ to $D_{L\ \text{with promotion}}$, then there is a net gain to the industry – a positive benefit to cost ratio (BCR).

How much of a return producers earn from the promotion depends on a number of factors such the responsiveness of lamb supply to a change in price as a result of promotion. A number of

researchers have reported that supply response can effectively prevent a long-term rise in producer price or even completely offset the effects of producer-funded commodity promotion (see, for example, Williams, Capps, and Lee, 2014; Kinnucan, Nelson, and Xiao, 1995; and Carman and Green, 1993).

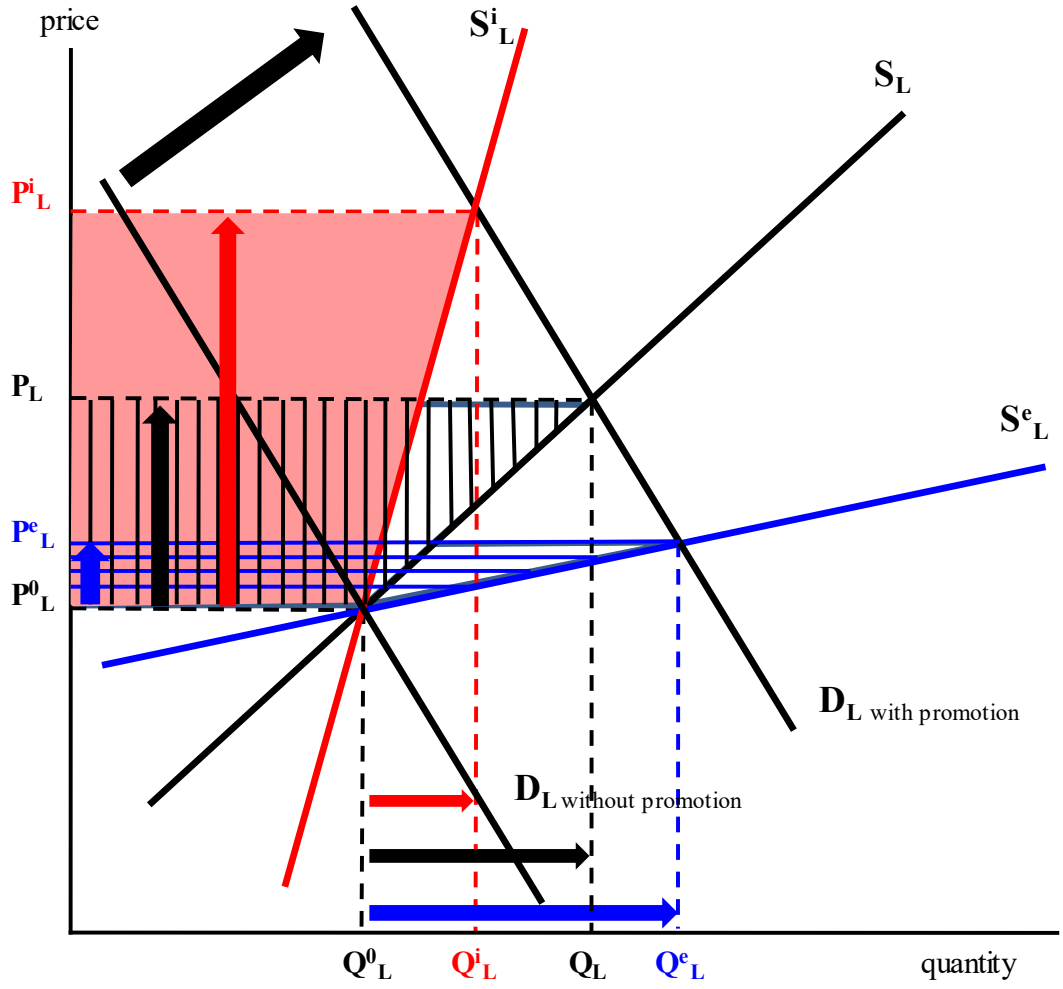
To illustrate the supply response issue, assume that the lamb supply is highly responsive to price changes (i.e., price elastic) as is the case with the blue supply curve S^e_L in Figure 3. Given the same demand shift as considered in Figure 2 of $D_{L\ \text{without promotion}}$ to $D_{L\ \text{with promotion}}$, then most of the market adjustment to a successful promotion program is manifest as an increase in sales (from Q^0_L to Q^e_L) rather than an increase in price (Figure 3). Even though the price increase from the promotion-induced demand shift is moderated by the vigorous supply response in this case, the lamb industry revenue increases by a greater percentage than the price increases over time because the quantity sold at the somewhat higher price also increases. The total cost of production also increases in this case but the increase in revenue given the demand shift in this case is greater than the cost increase so that the net effect on producer profits is still somewhat positive, represented by the small blue-lined area in Figure 3. Thus, while it could appear to individual producers that the promotion program was not successful in this case because the price did not increase much or as much as expected over time, in fact the program is successful in boosting farm revenues and even profits.

A much less price-responsive lamb supply (such as the red lamb supply curve S^i_L in Figure 3), however, would result in a higher price increase (P^0_L to P_i^L) relative to the increase in sales (Q^0_L to Q^i_L) as a result of the same promotion-induced demand increase ($D_{L\ \text{without promotion}}$ to $D_{L\ \text{with promotion}}$) and, thus, a larger positive effect on farm profits (represented by the light red area in Figure 3).

Thus, the extent of the increase in farm profits from a promotion-induced increase in demand depends on the responsiveness of supply to price over time (i.e., the long-run price elasticity of supply). For that reason, the counter-factual analysis considers a range of U.S. supply elasticities to determine a reasonable range of the return to producers from their promotion expenditures. The lamb promotion situation is more complicated than represented in Figure 3, however, because lamb is also supplied to the U.S. market by foreign suppliers (Australia and New Zealand). Thus, to determine a reasonable range of returns from promotion to the U.S. lamb industry, the price responsiveness of the supply of lamb coming from foreign suppliers must also be considered.

To measure the return to the U.S. lamb industry from its investment in lamb demand promotion, the differences between the economic surplus or profit to the lamb industry in the *with promotion* scenario and in each of the four *without promotion* scenarios discussed earlier are used as the "benefit" in each case for calculating the benefit-cost ratio (BCR) to the U.S. lamb industry in each of the four simulation scenarios.

Figure 3: Returns to the Lamb Industry from Lamb Demand Promotion with Different Lamb Supply Elasticities



Two BCRs are calculated in this study for each of the four simulation scenarios conducted: (1) the Retail Gross Revenue BCR (GBCR) and (2) the net economic Surplus (or profit) BCR (SBCR). The GBCR is calculated as the additional revenue generated over the life of the current lamb checkoff program (R) at the retail level net of the cost of the promotion (E) per dollar of promotion expenditure (E) over that same period:

$$(9)\quad GBCR = \sum_{t=1}^{T} \frac{R_t - E_t}{E_t}.$$

The SBCR is calculated by replacing the R (the retail-level revenue earned) in equation (9) with the additional economic surplus (profit) earned by the lamb industry as a result of the promotion (S) calculated as discussed in connection with Figures 2 and 3:

$$(10)\quad SBCR = \sum_{t=1}^{T} \frac{S_t - E_t}{E_t}.$$

The BCRs provide measures of the gross retail-level revenue (equation (9)) generated or the profit (equation (10)) earned by the U.S. lamb industry per dollar of expenditure by the ALB on lamb promotion. For the purposes of checkoff program evaluations, an SBCR of greater than 1.0 is taken as an indication that the promotional efforts have benefited stakeholders because stakeholder benefits (profit) increase by more than one dollar for every dollar spent on promotion. On the other hand, an SBCR of less than 1 is taken to mean that the promotion program has been an unprofitable investment for stakeholders since each dollar spent generates less than a dollar in additional benefit (profit).

ECONOMIC EVALUATION OF THE AMERICAN LAMB CHECKOFF PROGRAM

The economic evaluation of the lamb market effects and the returns to the U.S. lamb industry from its investment in the checkoff program follows the methodology outlined in the preceding section. First, the results of an econometric analysis of the effects of the checkoff program on U.S. lamb demand are presented. Those econometric results are then used in a counter-factual simulation analysis of the impacts of the lamb checkoff program on U.S. lamb markets, prices, and imports. Finally, the simulation results are used in a benefit-cost analysis to determine the ROI to the lamb industry from the lamb checkoff program.

Econometric Analysis of U.S. Lamb Demand

The econometric analysis of the U.S. per capita demand for lamb as specified in equation (7) above utilizes annual historical data for marketing years 1978/79 through 2022/23 (July/June). Years prior to the current lamb checkoff program (1978/79-2001/2002) were added to ensure statistical reliability in the estimated parameters. Data for U.S. lamb consumption (D in equation (7)) are available from USDA (2024) which are divided by population (POP) available from the Federal Reserve Bank of St. Louis (FRB, 2024) to calculate per capita U.S. lamb consumption (D/POP in equation (7)) over the period of analysis.

Retail prices for beef, pork, and poultry (P_i in equation (7)) are also available from USDA (2024). However, a consistently reported, reliable time series for the retail price of lamb (P in equation (7)) is still not available as discussed in some detail by Shiflett and Marsh (2015) and in the previous lamb ROI analysis (Williams and Hanselka, 2019). As done by Shiflett and Marsh (2015), we imputed values for the retail price of lamb over the study period to use for our lamb demand analysis. We tested various versions of a lamb price series based on the BLS retail lamb and mutton price index, the BLS lamb and organ meats index, historical price data available from USDA (Blazer, 1984) and from the Livestock Market Information Center (LMIC, 2010) as well as other sources. Based on model selection criteria (Akaike Information Criterion (AIC), the Schwarz statistic, and the Hannan-Quinn criterion), the retail price series selected for use in the lamb

demand analysis is based on a composite price index using the BLS retail lamb and mutton price index for 1978/79 through 2008/09 and the BLS lamb organ and meat price index for 2009/10 through 2016/17 from the Bureau of Labor Statistics (USDL, 2024). Because, the BLS lamb and organ price index was discontinued in 2017, values for the BLS lamb and organ price index for 2017/18 through 2022/23 were estimated using a regression with the BLS Meats Price Index (USDL, 2024) as the regressor. The composite price index was converted into a retail price series extending from 2009/10 through 2022/23 using actual retail prices for 1978/79 through 2008/09 obtained from the Livestock Marketing Information Center (LMIC, 2010) in the course of conducting a previous study of the return to lamb promotion (Capps and Williams, 2011)[3].

Data for lamb promotion expenditures (β in equation (8) to calculate G which is then used in equation (7)) were provided by ALB (2024). Data for personal disposable income (Y) and the consumer price index (1982-84=100) (I) in equation (7) were also obtained from the Federal Reserve Bank of St. Louis (FRB, 2024).

The results of econometrically estimating the parameters of the U.S. per capita lamb demand (equation (7)) are provided in Table 2. The regression statistics at the bottom of the table indicate an excellent fit of the data, notably the adjusted R-squared statistic of 0.978. Thus, the model explains about 98% of the changes in per capita lamb demand over the 1978/79 – 2022/23 period of analysis. In addition, the statistics indicate a lack of autocorrelation or serial correlation as given by the Durbin-Watson (DW) statistic just above 2.0 (2.144) and by the relatively low Durbin-h statistic (-0.772).

The real retail price of lamb is statistically significant with a price elasticity of -0.6321 (Table 2) which is quite consistent with the per capita lamb demand price elasticity estimated over several previous lamb ROI studies (Ghosh and Williams, 2014 and 2016 and Williams and Hanselka, 2018) as well as those of other lamb demand studies (see Shiflett and Marsh, 2015). In other words, the responsiveness of lamb demand to price has been quite stable over the years. These results suggest that while U.S. lamb price is a statistically significant driver of lamb demand, lamb demand is not highly responsive to changes in its price (i.e., the demand for lamb is inelastic). The estimated lamb price elasticity implies that a 10% increase in the lamb price leads to about a 6.3% decline in the demand for lamb.

The econometric results also indicate that beef and pork are substitutes for lamb (Table 2). A 10% increase in the price of beef results in about a 6.8% increase in the quantity of lamb demanded.

While the pork price is also found to be a statistically significant determinant of lamb demand, its effect on lamb demand is less than that of beef. A 10% increase in the price of pork results in about

[3] Retail lamb price data from LMIC were discontinued in 2008/09.

Table 2: Econometric Results for the U.S. Per Capita Demand for Lamb, 1978/79 – 2022/23

Dependent variable: Per capita lamb consumption (D/POP) (natural log)				
Variables (in natural logs except indicator variables)	**Estimate**	**Standard Error**	**t Value**	**P-Value**
Intercept	0.3695	0.4771	0.7744	0.4454
Real retail price of lamb (P/I)	-0.6321	0.0950	-6.6512	0.0000
Real retail price of beef (P_B/I)	0.6833	0.0908	7.5298	0.0000
Real retail price of pork (P_P/I)	0.1169	0.0908	1.2878	0.2087
Real retail price of broilers (P_B/I)	0.0419	0.0837	0.5007	0.6206
Real per capita disposable personal income (Y/POP/I)	0.2722	0.0686	3.9667	0.0005
Lagged per capita lamb consumption $(D/POP)_{t-1}$	0.5492	0.0620	8.8610	0.0000
Low lamb availability in 1994 (DLOW94)	-0.0623	0.0254	-2.4505	0.0210
Years of no checkoff in 1998 and 1999 (DNOCHECK)	0.1383	0.0368	3.7549	0.0008
Years of 201 assistance payments in 2000 and 2001 (D201ASST)	0.0822	0.0324	2.5404	0.0171
Consumer resistance to high price behavior (DRESIST13)	-0.0840	0.0287	-2.9290	0.0068
Statistical Discrepancy in 2002 (D2002)	0.0859	0.0255	3.3703	0.0023
Statistical Discrepancy in 2007 (D2007)	0.1008	0.0249	4.0513	0.0004
Statistical Discrepancy in 2015 (D2015)	-0.0757	0.0279	-2.7169	0.0114
Statistical Discrepancy in 2021 (D2021)	0.0846	0.0277	3.0609	0.0049
Goodwill Variable for Lamb Promotion Expenditures (G)				
Real lamb promotion expenditures in current period (G_t)	0.0047	0.0021	2.2011	0.0365
Real lamb promotion expenditures lagged one period (G_{t-1})	0.0062	0.0028	2.2011	0.0365
Real lamb promotion expenditures lagged two periods (G_{t-2})	0.0047	0.0021	2.2011	0.0365
Regression statistics: Adj. R^2 = 0.9776 DW = 2.144 Durbin-h = -0.772				

a 1.2% increase in the quantity of lamb demanded. We also included the real price of broilers as a potential driver of lamb demand. However, the results shown in Table 2 indicate no statistical significance of changes in the broiler price on the U.S. demand for lamb over the period of analysis. The implication is that lamb consumers do not consider poultry to be a substitute for lamb. That is, when the price of poultry changes, there is no statistically significant effect on the demand for lamb. This result is consistent with those of other published lamb demand analyses.

In contrast to nearly all previously published studies of the demand for lamb, we find that real (deflated) per capita income (Y/POP/I) has become a statistically significant driver of the demand for lamb with an elasticity of 0.2722. Thus, a 10% increase in real income increases lamb demand by about 2.7%. This finding is important because it implies that as the economy and consumer incomes grow, more lamb is sold.

Following previous lamb demand studies, the lagged dependent variable (D/POP_{t-1}) was included as a regressor in the per capita lamb demand equation of the lamb industry model to account for the effects of habit persistence. The results support previous findings of statistically significant habit persistence in U.S. lamb consumption. With habit persistence, past consumption of a good influences current preferences and demand. Thus, a higher level of consumption of a good in one period, holding all else constant, implies a higher level of consumption of that good in the next period. The finding of statistically significant habit persistence for U.S. lamb demand is reasonable given that lamb is consumed primarily by ethnic groups that persist in consuming lamb from year to year regardless of other factors influencing that demand like changes in prices or income. The relatively low estimated coefficient for lagged per capita lamb consumption (0.5492) indicates that lamb consumers adjust their lamb consumption from one period to the next rather quickly.

A number of indicator variables were included in the model, some of which account for specific events that have affected lamb consumption over the years that are not captured by the other regressors in the model. Others account for statistical discrepancies in the data as identified by the econometric analysis. What we term "lamb consumption" data in this report is, in fact, disappearance data meaning that it is calculated by the USDA as the residual between data collected for lamb supply (production plus imports) and other demand components (change in stocks and exports). Because the various components of "lamb disappearance" are collected by different agencies (the U.S. Department of Commerce, the USDA National Agricultural Statistics Service, and others) by different methods, the disappearance data include resulting statistical discrepancies (meaning that they are not likely to add up with precision to give an exact number for actual lamb consumption). The indicator variable DLOW94 accounts for the effects of a lamb supply shortage in 1994/95 that affected the availability of lamb for consumption in that year (Table 2). DNOCHECK is an indicator variable for the years 1998/99 and 1999/2000 when there was no checkoff program in place. The coefficient for the indicator variable D201ASST indicates that the 201 assistance payments in 2000/01 and 2001/02 had positive and statistically significant impacts on lamb demand in those years. The indicator variable DRESIST13 represents the period in 2013/14 when lamb prices increased rapidly and set near record levels creating some potential consumer resistance at retail (Shiflett, 2015). The indicator variables D2002, D2007, D2015, and D2021 represent statistical discrepancies in the USDA lamb disappearance in 2002/03, 2007/8, 2015/16, and 2021/22, respectively, as determined by inspection of the regression residuals and are all statistically significant in explaining changes in the USDA lamb disappearance data over the period of analysis.

Lamb promotion expenditures are found to be a statistically significant driver of lamb demand. The short-run promotion elasticity of U.S. lamb demand is estimated to be 0.0047 over the full period of 1978/79-2022/23 (variable G_t in Table 2). The medium-run promotion elasticity over that period is estimated to be 0.0156 (the sum of the coefficients of G_t, G_{t-1}, and G_{t-2} in Table 2). The long-run promotion elasticity is 0.0346 (the medium-run elasticity divided by one minus 0.5492, the coefficient of the lagged dependent variable). The estimated long-run elasticity is nearly identical to the long-run promotion elasticities reported in the last two previous ROI analyses for the lamb checkoff program of 0.0328 in the 2018 report (Williams and Hanselka, 2019) and 0.037 in the 2014 report (Ghosh and Williams, 2014). The statistical results indicate that a doubling of lamb promotion expenditures (that is, a 100% increase) would result in 0.47% increase in per capita lamb consumption within one year, a 1.56% increase after three years, and a 3.45% increase over the long-run.

Simulation Analysis of the Lamb Checkoff Program

Using the U.S. lamb industry model developed for the previous lamb promotion ROI analysis and the updated price and promotion elasticities from the econometric model of U.S. per capita lamb demand reported in the preceding section, four separate counterfactual simulations were conducted to determine a reasonable range for the changes in U.S. lamb production, consumption, prices, and imports as a result of lamb promotion over the history of the current lamb checkoff program (2002/03 through 2022/23). The four simulations correspond to a likely range of long-run price responsiveness of U.S. lamb production and of foreign export supplies of lamb to the United States as discussed in the methodology section. The four simulations include the following:

(1) Both the U.S. and foreign export supply price elasticities are set at their upper bounds (highest plausible levels of 5.0 and 2.0, respectively);

(2) U.S. lamb supply price elasticity is set at its upper bound (highest plausible level) of 5.0 but the price elasticity of foreign export supply is set at its lower bound (lowest plausible level) of 1.0;

(3) U.S lamb supply price elasticity is set at its lower bound (lowest plausible level) of 1.0 but the price elasticity of foreign export supply of lamb is set at its upper lower bound (highest plausible level) of 2.0; and

(4) Both the U.S. and foreign export supply price elasticities are set at their lower bounds (lowest plausible levels) of 1.0 for each.

The results of the four simulations are shown in Table 3. The salient result is the 1.7% to 1.9% lift ($1.17 billion to $1.31 billion) in the total retail value of lamb consumption over 2003/04 to 2022/23 as a result of promotion by the American Lamb Board depending on the price responsiveness of U.S. and foreign lamb supplies. The "lift" is the average annual increase (or percent increase) in the indicated variables over the corresponding years. Thus, between $1.17 billion (1.7%) and $1.31 billion (1.9%) of the total value of U.S. lamb consumption between

2003/04 and 2022/23 is the direct result of the promotion efforts of the American Lamb Board, an annual average increase (lift) of between $58.7 million and $62.4 million. The lift in the value of consumption over those years is the result of both a lift in lamb consumption due to ALB promotional activities (an annual average of 1.0% to 1.3%) and a more modest lift in the retail lamb price (0.3% to 1.0% on average) over 2003/04 to 2022/23 (Table 3) due to the demand lift. The lift through 2022/23 is somewhat lower than reported in the previous analysis through 2017/18 because promotion expenditures over the last five years (2018/19 through 2022/23) were substantially lower than the mean expenditure of the previous 15 years (2003/04 through 2017/18) (see Figure 1). The result was that the average annual effect of promotion on lamb sales over the full period (2003/04 to 2022/23) was reduced.

The price lift during that period stimulated a lift in U.S. lamb production of about 0.7% to 2.3% and a smaller 0.5% to 1.4% lift in lamb imports which muted the price response to the promotion-induced demand lift somewhat (Table 3). Note that as the price elasticity of the supply of lamb declines (i.e., when price elasticities of both domestic and foreign supplies of lamb are at their lower bounds (abbreviated LB in Table 3), more of the response to the promotion tends to manifest as a price increase rather than as increase in consumption and production.

Note also that the positive promotion lift of U.S. production tends to be much larger than the measured lift in lamb imports in simulations 1 and 2 in which the long-run supply of lamb is at the upper bound (abbreviated UB) of 5.0 (Table 3). The opposite occurs when the elasticity of U.S. lamb supply is at its lowest level (lower bound of 1.0). Given that U.S. lamb production is likely much more price responsive than the supply of lamb coming from export suppliers as discussed in the methodology section, the results of simulation 2 in Table 3 reflect the most plausible results. For that simulation, the 3.72 million lb (2.3%) lift in U.S. lamb production from promotion over the 2003/04 through 2022/23 period is substantially larger than the 1.05 million lb (0.5%) lift in U.S. lamb imports over that same period as a result of ALB promotion (Table 3). As a result, the U.S. production share of total U.S. lamb consumption is also higher by 0.43% (see Figure 4). Thus, ALB promotion programs have not only increased U.S. lamb consumption and production but also the U.S. production share of U.S. consumption to some extent over time (Figure 4).

Benefit-Cost Analysis of the Lamb Checkoff Program

The simulation results of the market effects of promotion as summarized in Table 3 provide the data necessary for calculating a reasonable range for the benefit-cost ratio (BCR) from lamb promotion. Given the total lift in retail lamb sales (total increase in the value of lamb consumption from promotion) of $1.17 billion to $1.31 billion over the 2003/04 to 2022/23 period and total promotion expenditures of $29.8 billion[4] over that period (Table 4), the retail gross revenue BCR (GBCR in Table 4) ranged from $38.4 to $42.9 per dollar of investment. The return to

[4] Only expenditures for promotion as shown in Figure 1 are included. Total ALB revenues and expenditures included administrative costs and other expenditures not specifically allocated to advertising and promotion.

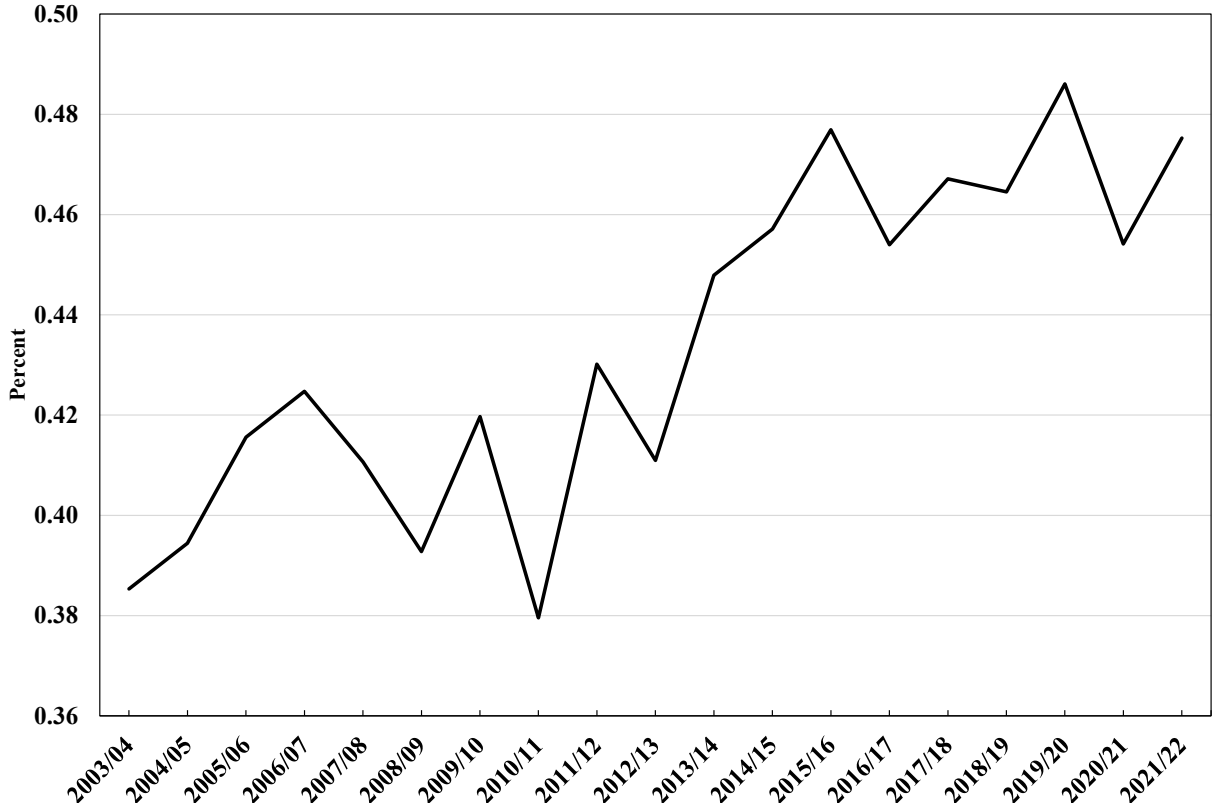
Table 3: Averge Annual Lift* of U.S. Lamb Market from ALB Checkoff Program, 2003/04-2002/23

	Average Annual Lift Under Four Sets of Alternative Elasticity Assumptions**			
Average Annual Lift of:	(1) Both at UB	(2) DS at UB ES at LB	(3) DS at LB ES at UB	(4) Both at LB
U.S. Production (1,000 lb)	3,177.0	3,721.8	1,149.6	1,544.3
Percent lift	2.0%	2.3%	0.7%	0.9%
U.S. Consumption (1,000 lb)	4,939.1	4,768.3	4,219.6	3,632.4
Percent lift	1.3%	1.3%	1.1%	1.0%
Imports (1,000 lb)	1,762.1	1,046.5	3,070.0	2,088.1
Percent lift	0.8%	0.5%	1.4%	1.0%
U.S. Production Share of Consumption (%)	0.3%	0.4%	-0.2%	0.0%
Retail Price (¢/lb)	3.1	3.6	6.3	8.5
Percent lift	0.3%	0.3%	0.7%	1.0%
Value of Consumption ($1,000)	1,174,333.2	1,193,124.3	1,247,014.7	1,309,947.1
Percent lift	1.7%	1.8%	1.8%	1.9%

* The "lift" is the average annual increase in the indicated variables over the corresponding years.

** Upper bounds (UB) of elasticities of domestic supply (DS) and foreign export supply (ES) = 5 and 2, respectively. Lower bounds (LB) = 1 and 1, respectively.

Figure 4: **Addition to U.S. Production Share of U.S. Lamb Consumption from ALB Promotion, 2003/04-2022/23***



* Results from simulation 2, the most likely scenario.

the lamb industry from promotion in terms of additional industry profit (SBCR), however, ranges from $16.6 to $33.8 per promotion dollar (Table 4). Given that U.S. lamb production is likely much more price responsive than the supply of lamb coming from export suppliers, as discussed in the methodology section, then the SBCR result for simulation 2 in Table 4 of $16.6 per dollar of promotion most plausibly represents the returns to the U.S. lamb industry from ALB lamb promotion over the 2003/04 to 2022/23 period.

That result is slightly higher than reported in the last two ROI studies of $14.4 in the 2014 report (Ghosh and Williams, 2014) and the $14.2 in the 2019 report (Williams and Hanselka, 2019) despite the substantially lower promotion expenditures made in the last five years (see Figure 1). There are three potential reasons for the higher BCR measured in this report. The first is that, despite lower expenditures over the last five years, ALB has more effectively invested each promotion dollar over that period. However, our econometric analysis of the influence of promotion on lamb demand indicates that ALB effectiveness in demand enhancement to be almost identical in this report, which includes five more years of data, compared to what was found in the previous report. For the analysis in both reports, we calculated a promotion effectiveness metric that measures the percentage change in lamb demand over the period of analysis from a one percent

Table 4: ALB Checkoff Promotion Program Benefit Cost-Analysis, 2003/04-2002/23

Total Promotion Expenditures ($1,000)	$29,821			
Historical Retail Value of Lamb Sales ($1,000)	$69,129,315			
Chekoff Investment Intensity Ratio*	0.04%			
	Benefit-Cost Analysis Under Four Sets of Alternative Elasticity Assumptions**			
	(1)	(2)	(3)	(4)
	Both at UB	DS at UB ES at LB	DS at LB ES at UB	Both at LB
Lamb Consumption Value Added by Promotion ($1,000)	$1,174,333	$1,193,124	$1,247,015	$1,309,947
Share of consumption value added by promotion	1.7%	1.8%	1.8%	1.9%
Retail Gross Revenue BCR (GBCR)***	38.4	39.0	40.8	42.9
Industry Profit (Economic Surplus) BCR (SBCR)***	19.4	16.6	34.1	33.8

* Promotion-to-sales ratio

** Upper bounds (UB) of elasticities of domestic supply (DS) and foreign export supply (ES) = 5 and 2, respectively. Lower bounds (LB) = 1 and 1.

*** Benefit-Cost Ratio (BCR) with industry cost of promotion netted out.

change in promotion expenditures. Referred to as the "long-run promotion elasticity," that metric changed only marginally when the last five years of data were added to the analysis. In the previous report, we found that for every 1% increase in promotion expenditure, lamb demand increased by 0.033% over the period through 2017/18. Past research across a large number of checkoff programs indicates that metric or "promotion elasticity' to be relatively high. When we added the data for the last five years through 2022/23, the long-run promotion elasticity increased only marginally to 0.034%. Thus, promotion effectiveness has not changed over the last five years, remaining at a relatively high level among checkoff promotion programs.

The second potential reason that the BCR increases in this report, persistence of promotion effects, is likely to be a contributing factor. As demonstrated by a large body of research, promotion tends to have carryover effects on demand (see, for example, Capps, Bessler, and Williams, 2016). Thus, the effects of expenditures on demand tend to persist over time before declining. As we discussed in the methodology section, we found that lamb promotion expenditures in any given year tend to have effects on lamb demand over three years, increasing from the year of expenditure to a higher level in the next year and then lower again in the third year before dissipating altogether. In fact, all previous analyses of the lamb checkoff program have found a similar pattern of persistence of promotion effects on demand consistent with long research on advertising and promotion across a large number of commodities. Thus, when expenditures dropped over the last five years (2018/19-2022/23), the demand effects resulting from previous expenditures persisted, that is, carried over, beyond the period of expenditure. Thus, added revenues from promotion did not drop immediately when expenditures dropped so that the BCR increased.

A third explanation is also a contributing factor to the higher BCR reported in this study. Extensive research has also demonstrated that the higher checkoff program expenditures are, the lower the BCR tends to be (see, for example, Williams, Capps, and Hanselka, 2018). Thus, the BCRs for higher funded checkoff programs like dairy, cotton, and soybeans tend to be much smaller (around $2 to $8 per dollar of promotion) than the smaller programs like lamb. The research demonstrates that as promotion expenditures rise, the dollar returns also increase but at a slower rate, a phenomenon known as decreasing returns to scale. So, as expenditures rise, the BCR tends to drop. The opposite is true for decreases in expenditures so that a BCR tends to be higher at lower levels of expenditure. For lamb, the consequence of the lower lamb promotion expenditures over the last five years is that the lower level of expenditures contributed to a higher BCR. For these reasons, the market effects of promotion shown in Table 3 are more reliable, straight-forward, and easier to compare measures of the effectiveness of the ALB program over the years than the BCR measures shown in Table 4.

CONCLUSIONS AND IMPLICATIONS

This study updates the previous analysis of the effectiveness of the American Lamb Checkoff Program (Williams and Hanselka, 2019) through 2022/23. The primary objectives of the study were to determine: (1) the effects of the American Lamb Checkoff Program on U.S. lamb markets and (2) the returns to the U.S. lamb industry from its investment in the checkoff program (the ROI) over 2003/04 through 2022/23. An econometric simulation model of the U.S. lamb industry developed in conducting the analysis for the previous report was updated and used in the analysis presented in this report to achieve the objectives. The simulation analysis focuses on the effects of the lamb checkoff promotion on U.S. lamb demand, production, imports, and prices over the years of 2003/04 through 2022/23. The results of the simulation analysis were then used in a benefit-cost analysis to determine the return on the investment by the U.S. lamb industry in the lamb checkoff program over that period.

The major conclusions of this study include the following over the years of 2003/04 to 2022/23:

- *Effects of the ALB Checkoff Program on U.S. Lamb Markets*

  The study results indicate that the ALB lamb checkoff program has had a statistically significant effect on U.S. lamb demand over the years. The salient result is that the promotional activities of the American Lamb Board added between $1.17 billion (1.7%) and $1.3 billion (1.9%) to the total value of U.S. lamb consumption since the beginning of the program (2003/04 to 2022/23), an annual average of between $58.7 million and $62.4 million, depending on the assumed price responsiveness of U.S. and foreign lamb supplies. That range is somewhat smaller than the 2.4% to 2.7% range reported in the previous report over 2003/04 through 2017/18 period because of the substantially lower average annual promotion expenditures that occurred during the most recent five years of the analysis (2018/19 through 2022/23) which brought down the average over the full period. Nevertheless, the results show that with rather modest funds available for promotion, the ALB has succeeded in substantially enhancing the value of U.S. lamb consumed. The increase in the value of consumption was the result of both a higher level of lamb consumption due to ALB promotion by an annual average of 1.0% to 1.3% and a more modest addition to the retail lamb price of 0.3% to 1.0% on average over 2003/04 to 2022/23. The higher price during that period stimulated a higher level of both U.S. lamb production by 0.7% to 2.3% and lamb imports by a smaller 0.5% to 1.5% which muted the price response to the promotion somewhat.

- *Return to the U.S. Lamb Industry from Lamb Promotion*

  The results indicate that the return to the U.S. lamb industry from ALB promotion over the period of 2003/04 to 2022/23 in terms of additional profit was $16.6 per dollar of promotion, a somewhat higher benefit-cost ratio than the $14.4 per dollar of promotion reported in the previous evaluation despite lower expenditures in the last five years of the analysis (2018/19-

2022/23). Two main factors account for the higher result, including carryover effects of promotion in previous years and a phenomenon known as decreasing returns to scale. As a large body of research shows for a wide variety of commodities, promotion in one period tends to affect consumer behavior not only in the year of expenditure but also in succeeding periods before dissipating. For lamb, we have consistently found that expenditures in one year affect consumption not only in the year of expenditure but also over the next two years before dissipating in effect. Thus, even though expenditures declined in the last five-year period of the current analysis from 2018/19-2022/23, the value of lamb sales added by promotion tended to remain at previous levels for at least a few years before declining so that the BCR tended to increase over that period. The second reason for the higher BCR in this study is, counterintuitively, the lower promotion expenditures over the last five years. Extensive research demonstrates that as promotion expenditures rise, the dollar returns also increase but at a decreasing rate, a phenomenon known as decreasing returns to scale. So as expenditures rise, the BCR tends to drop. The opposite is true for decreases in expenditures. When expenditures decline, the dollar returns tend to decline at a slower rate so that the BCR tends to increase. For lamb, the consequence of these two factors (carryover effects and decreasing returns to scale) was a slightly higher average BCR of $16.6 per dollar of promotion over the 20-year period of 2003/04 to 2022/23 compared to the $14.4 per dollar of promotion found in the previous study for the 15 years of 20023/04 through 2017/18 despite lower expenditures over the five years between the two studies.

These results lead to a number of implications for the American lamb checkoff program.

First, the most meaningful metric of program effectiveness in enhancing lamb demand is the $1.17 billion (1.7%) to $1.31 billion (1.9%) that has been added to the total value of lamb sales by the checkoff program over the last 20 years, an annual average of between $58.7 million and $62.4 million. The message that ALB has added such substantial value to lamb consumption over the lifetime of the program is powerful given that lamb checkoff expenditures have amounted to only about 0.04% of the total value of consumption over that period. This metric of impact is more understandable and more believable than a high BCR which is often misunderstood to imply an unreasonably high market impact. The share of the value of lamb sales that ALB can take credit for may help stakeholders understand what they are getting for their checkoff dollars.

Second, the high BCR calculated for the lamb checkoff program is not indicative of the level of impact of the program on the U.S. lamb industry. The small amount of lamb checkoff funds expended in each year generated a positive but rather small lift for the industry. The small positive benefit divided by an even smaller checkoff expenditure resulted in a relatively large BCR. Checkoff groups sometimes interpret estimated BCRs much in excess of 1:1 to imply large absolute impacts of their program on the market. Such is not the case, however. A BCR of 16.6 to 1, for example, results by dividing a $16.6 billion industry profit benefit by a $1 billion checkoff investment or by dividing only a $16.6 benefit by a $1 investment. Thus, the BCR indicates only

the return generated from the investment made and not the level of impact the program has on lamb demand or price.

Third, the highly positive BCR calculated for the lamb checkoff program in this study, which is actually much in excess of the BCRs calculated for the larger and more mature programs like soybeans, cotton, beef, and pork, does not indicate that the lamb checkoff program is much more effective than the larger checkoff programs. Small promotion programs like that for lamb have consistently been found to result in higher BCRs than is the case for much larger checkoff programs primarily because of the principle of decreasing returns to scale. As promotion expenditures increase, the returns also tend to increase but at a slower rate so that the return per dollar spent tends to decline. Because the larger checkoff programs spend much in excess of $100 million per year on promotion, their BCRs tend to average about $2-$8 per dollar spent (Williams, Capps, and Hanselka, 2018). Because they spend so much more in total on promotion, however, the absolute impact of their programs on their markets is also remarkably higher.

Finally, despite the increase in the lamb checkoff assessment that was passed in 2013 and subsequent changes in how the funds are collected, the program continues to be vastly underfunded, imposing a huge opportunity cost on industry stakeholders of potentially millions of dollars. The results indicate that for every dollar in additional assessment NOT paid by stakeholders and, thus, not spent on lamb promotion, industry stakeholders lose an average of $16.6 in potential additional industry revenue. Of course, as indicated above, increases in checkoff assessment rates and total spending on promotion are usually accompanied by a reduction in the corresponding BCR. Thus, the rebound of promotion expenditures in the post-COVID years is expected to return the lamb checkoff BCR to a level more consistent with what was reported in previous studies. Nevertheless, with such a high estimated BCR, the industry could increase the assessment rate and expenditures substantially above current levels and still expect to generate a reasonably high rate of return, much above those earned by the beef, pork, cotton, soybeans, and other larger checkoff programs.

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