RETURN ON INVESTMENT IN THE AMERICAN LAMB CHECKOFF PROGRAM

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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 2.4% and 2.7% of the annual average retail value of U.S. lamb consumption between 2003/04 and 2017/18 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 $14.2 in additional industry profit per dollar invested in promotion. In addition, the analysis found that the promotion program has substantial impacts on the US. economy far beyond just the lamb industry.

RETURN ON INVESTMENT IN THE AMERICAN LAMB CHECKOFF PROGRAM

EXECUTIVE SUMMARY

T his study is an updated evaluation 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. The primary objective of this study is to answer two related questions: (1) What have been the effects of the American Lamb Checkoff Program on U.S. lamb markets? (2) What have been the returns to the U.S. lamb industry from its investment in the checkoff program (the ROI)?

Although not specifically requested as part of this study, this report also explores the extent to which the additional lamb industry economic activity and revenues generated by the American Lamb Checkoff Program benefit the larger U.S. economy. The report explores the importance of the lamb market impacts from lamb promotion in the broader context of the U.S. economy with a focus on answering two additional questions: (1) What has been the contribution of the American Lamb Checkoff Program to the overall U.S. economy? (2) What has been the industry distribution of the contribution of the American Lamb Checkoff Program to the U.S. economy?

An econometric simulation model of the U.S. lamb industry is developed to answer the first two questions. The model 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. To address the additional two questions, we conduct an economic contribution analysis and measure the economic multiplier effects of the additional value of lamb consumption generated by the lamb checkoff program since its effective implementation (2003/04 – 2017/18). The process provides measures of the contribution of the lamb checkoff program to the value of U.S. output, U.S. value-added, employment, labor income, and taxes paid (federal, local, and state-level) since the effective beginning of the program in 2003/04.

Key findings for the 2003/04 to 2017/18 period of ALB promotion include the following:

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

- With modest funds available for promotion, the ALB succeeded in substantially enhancing the annual value of U.S. lamb consumed by between $62.2 million (2.4%) to $70.3 million (2.7%).

- 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 1.5% to 1.9% and a more modest addition to the retail lamb price of 0.5% to 1.3% on average over 2003/04 to 2017/18.

- The higher price during that period stimulated a higher level of both U.S. lamb production by about 1% to 2.8% and lamb imports by a smaller 0.6% to 1.9% which muted the price response to the promotion somewhat.

Returns to the U.S. Lamb Industry

- The return from ALB promotion in terms of additional industry profit ranged from $14.2 to $33.4 per promotion dollar.

- The lower benefit-cost ratio (BCR) of 14.2 is the most plausible result and corresponds closely with the BCR of 14.44 reported in the previous lamb checkoff ROI analysis.

Contribution of the American Lamb Checkoff Program to the Overall U.S. Economy

The aggregate $932.5 million to $1.054 billion in additional retail value of lamb consumption resulting from the ALB promotion program over the years made substantial contributions to the U.S. economy, including:
- $2.0 - $2.3 billion of U.S. output or total consumer spending;
- $871 - $985 million of the U.S. GDP (value-added);
- $534 - $603 million of the U.S. labor income;
- $192 - $216 million of the taxes paid (federal, state, and local); and
- 821 - 927 jobs to the economy on average in a given year over the period.

Industry Distribution of the Economic Contribution of the American Lamb Checkoff Program

- Agriculture, services, and manufacturing sectors account for 81% of the contribution of the additional net retail value of lamb consumption to U.S. gross output, 74% of contribution to the U.S. GDP (value-added), 77% of the contribution to U.S. employment, 73% of the contribution to U.S. labor income, and 52% of the contribution to U.S. taxes.

- The wholesale/retail industries account for 10% of the contribution to gross output, 15% of the contribution to GDP, 14% of the contribution to labor income, 15% of the contribution to employment, and 38% of the contribution to taxes.

- Transportation and warehousing and a large number of miscellaneous services (such as advertising, insurance, accounting and legal services, repair services, and more) account for much of the remaining contribution.

A few implications of the analysis for consideration include the following:

- *Perhaps the most meaningful metric of program effectiveness in enhancing lamb demand is the 2.4% to 2.7% of the annual value of lamb sales consumption that has been added by lamb promotion.*

The message that ALB has added from 2.4% to 2.7% to the annual value of lamb consumption is powerful and perhaps more understandable and even believable than a high BCR. High BCRs are often misunderstood to mean high 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.

- *ALB promotion not only is enhancing lamb demand at a high ROI, it is also making a substantial contribution to the U.S. economy.*

  The importance of the lamb checkoff program to not only the lamb industry but also to many businesses and people across the nation is a story that could be a useful addition to discussions about support for the checkoff program by potential, strategic partners along various economic supply chains.

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

  The high BCR primarily reflects the relatively small size of the lamb checkoff program compared to those of other major commodities. Stakeholders in many other checkoff programs pay more and contribute a much higher share (up to 15 to 30 times higher) of their industry revenues to their respective checkoff programs than do lamb industry stakeholders. Research has shown that as the level of checkoff expenditures grows, the marginal impact of each additional dollar spent declines. So for a large checkoff program like soybeans, the BCR is lower than for lamb but with $100 million or more being spent, the absolute impact of their checkoff activities on their markets is also much greater.

- *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 14.2 means that for every dollar in additional assessment NOT paid by stakeholders and spent on lamb promotion, industry stakeholders lose an average of $14.2 in additional industry revenue. Further increases in the assessment might lead to some reduction in the BCR. But with such a high estimated BCR, the industry could increase the assessment rate substantially beyond even the new levels and still expect to generate a quite reasonable rate of return.

- *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. A BCR of 14:1 results by dividing a $14 billion industry profit benefit by a $1 billion checkoff investment or by dividing a $14 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.

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T his study is an update of the last 5-year evaluation of the return on investment (ROI) in the American Lamb Checkoff Program (Ghosh and Williams, 2014). This updated program evaluation is 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. The primary objective of this study is to answer two related questions: (1) What have been the effects of the American Lamb Checkoff Program on U.S. lamb markets? (2) What have been the returns to the U.S. lamb industry from its investment in the checkoff program (the ROI)?

Although not specifically requested as part of this study, this report also explores the extent to which the additional lamb industry economic activity and revenues generated by the American Lamb Checkoff Program benefit the larger U.S. economy. The basic objective of the analysis is to determine whether the benefits derived by lamb industry stakeholders from the lamb checkoff program have broader economic implications. More specifically, the reports explores the importance of the American Lamb Checkoff Program to the U.S. economy with a focus on answering two additional questions: (1) What has been the contribution of the American Lamb Checkoff Program to the overall U.S. economy? (2) What has been the industry distribution of the contribution of the American Lamb Checkoff Program to the U.S. economy?

An econometric simulation model of the U.S. lamb industry is developed to answer the first two questions. The model 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. To address the additional two questions, we conduct an economic contribution analysis and measure the economic multiplier effects of the additional revenue generated by the lamb checkoff program since its effective implementation (2003/04 – 2017/18). The process provides measures of the contribution of the lamb checkoff program to the value of U.S. output, U.S. value-added, employment, labor income, and taxes paid (federal, local, and state-level) since the effective beginning of the program in 2003/04.

The report begins with some background on the American Lamb Checkoff Program. A discussion of the methodologies employed in the return on investment analysis as well as in the economic contribution analysis are then described. The results of employing those methodologies to ascertain answers to the questions posed earlier are then discussed. The report ends with concluding comments and implications for the management of the lamb checkoff program.
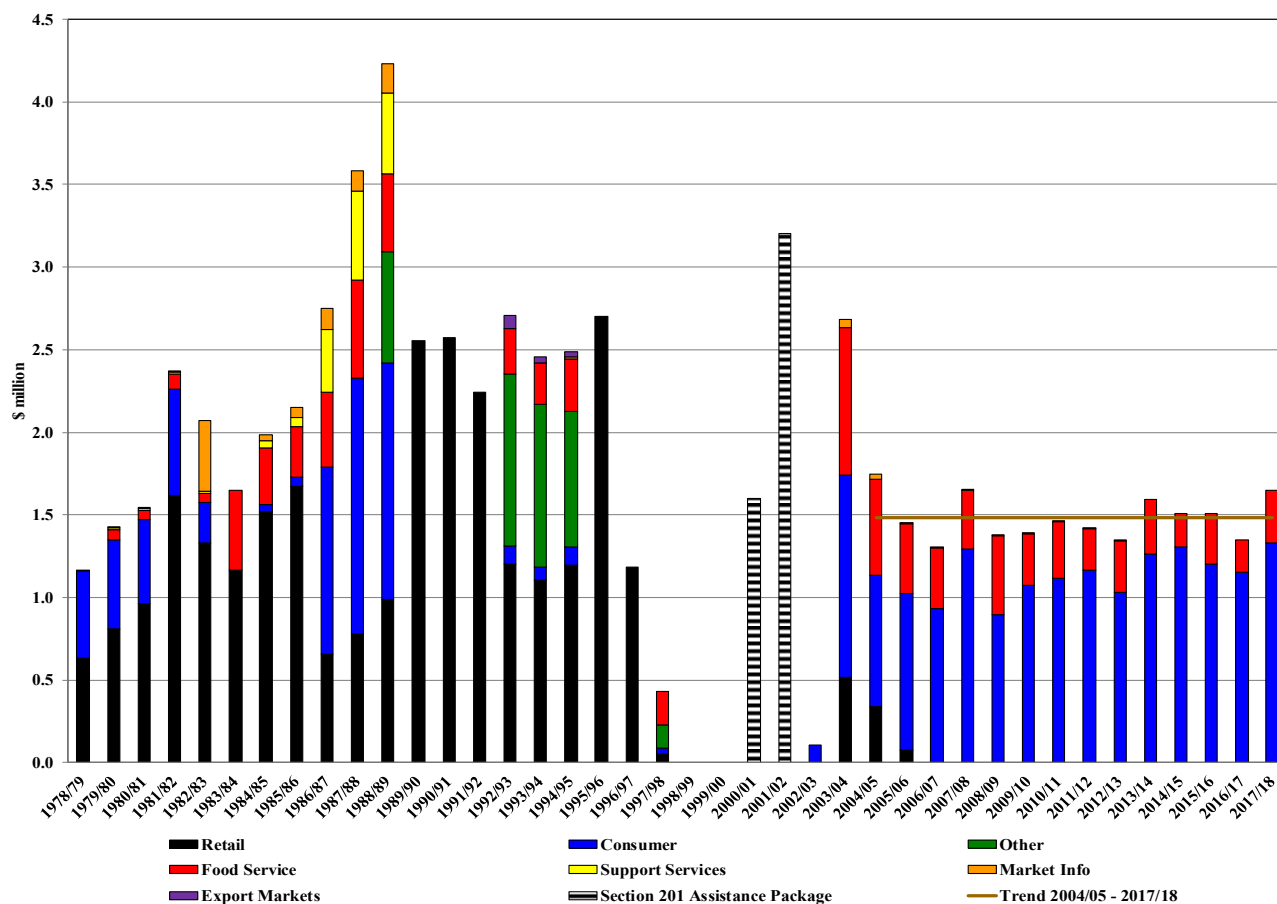
THE AMERICAN LAMB CHECKOFF PROGRAM

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. 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 (Figure 1). During those years, most of the funds dedicated to lamb promotion were allocated to promotional activities in four main areas: (1) retail marketing and promotion aimed primarily at the retail food store trade (theme promotions and contests, recipes, conventions, etc.); (2) 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, and other media/promotional support, etc.); (3) food service promotion, including the development and placement of advertising with food service establishments, exhibits at culinary promotional events, etc.; and (4) support programs for buyers and merchandisers such as tours and staff training, technical and educational services, etc. During the 1990s, most of the available promotion funds were shifted to retail promotion activities with spending on little else except a few special projects in a few years (Figure 1).

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 inside tariff was set at 9% in the first year and reduced to 6% in the second year and 3% in the third year. Outside tariff rates were set at 40% in the first year declining to 32% in the second year, and 24% in the third year. 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 (Figure 1). Most of the funds were allocated to ASIA for lamb identification and food service promotion and retail promotion. The rest of the funds were allocated to packers, breakers, and processors to promote lamb products to retailers and food service outlets.

The current lamb checkoff program was initiated in 2002 following another producer referendum. Since 2003/04 (the first effective year of expenditures) through 2017/18, the American Lamb Board (ALB), charged with the use and management of the checkoff funds, has spent a total of just over $23.4 million on lamb promotion, an average of about $1.56 million per year, lower than the $2 million to $3 million spent each year on lamb promotion during the 1990s by ASIA. Since 2004/05, the trend in spending has been flat at about $1.48 million (see trend line in Figure 1).

Figure 1: Lamb Promotion Expenditures by Category, 1978/79 – 2017/18

The main objective of the current Lamb Checkoff Program is to increase demand for "American" lamb as opposed to lamb in general which includes imported lamb (American Lamb Board 2018a). 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 weight gain. U.S. lamb imports are not subject to the assessment. Since 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 increased to $0.007 while the per-head assessment on lambs purchased for slaughter increased to $0.42.

Compared to the value of U.S. lamb consumed each year, the amount of funds that the lamb checkoff program collects and 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) over the 1978/79 to 2017/18 period ranged from a minimum of zero in 1998/99 and 1999/00 to a high of 0.36% in 1988/89, averaging 0.21% between 1978/79 and 1997/98 but only 0.06% since 2003/04 which was the first full year of operation of the current lamb checkoff program (Figure 2). 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. Administrative costs under the current program are kept low so that most of the collected checkoff funds are used for promotional purposes. The U.S Department of Agriculture (USDA) oversees the operation of the checkoff program.

STUDY METHODOLOGY

In this updated analysis of the American Lamb Checkoff Program, we employ two sets of methodologies. First, to answer the questions regarding the effect of the lamb checkoff program on U.S. lamb demand, markets, and price, we develop a model of the U.S. lamb industry that we use in a counter-factual simulation analysis of the quantity and price effects of lamb promotion expenditures over different periods and the associated ROI measures. To determine the effects of lamb promotion on the general U.S. economy beyond the lamb industry, we conduct an economic contribution analysis using IMPLAN (IMPact model for PLANning).

Return on Investment Analysis (ROI) Methodology

To measure the relationship between lamb promotion and U.S. lamb markets, an economic model of the U.S. lamb industry is first developed and discussed. The process of using the model in a counter-factual simulation analysis to determine the lamb market impacts of promotion is then discussed. Finally, the use of the simulation results to calculate the benefit-cost ratio (BCR) for lamb promotion, the most appropriate ROI measure, is then laid out.

U.S. Lamb Industry Model

The U.S. lamb industry can be represented as an economic model by the following six equations:

(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.

To determine the effect of promotion (β_L), we first assume that no exogenous variable other than those expenditures are allowed to change (that is, $d\alpha_L = d\beta_L = d\beta_O = d\theta_F = d\alpha_{ES} = 0$, where the operator "d" is the total derivative and can be interpreted as "total change in". Thus, in the analysis of the effect of promotion on the U.S. lamb market no exogenous force (variable) other than promotion (β_L) is allowed to change in order to isolate the specific effects of promotion on that market. Also, we expect that promotion expenditures have a positive effect on lamb demand ($\frac{\partial D_L}{\partial \beta_L} > 0$) and that the change in promotion expenditures is positive ($d\beta_L > 0$) where "∂" is the partial derivative operator such that $\frac{\partial D_L}{\partial \beta_L}$ is understood to be the change in lamb demand (D_L) given a one unit change in promotion expenditures (β_L) holding all else constant ("ceteris paribus").

Given the model in equation (1) to (6) above, we totally differentiate each equation to obtain:

(1') $\quad dS_L = \frac{\partial S_L}{\partial P_L} dP_L$

(2') $\quad dD_L = \frac{\partial D_L}{\partial P_L} dP_L + \frac{\partial D_L}{\partial \beta_L} d\beta_L$

(3') $\quad dM_L = dD_L - dS_L$

(4') $\quad dP_L = \frac{\partial P_L}{\partial P_F} dP_F$. Assuming $\frac{\partial P_L}{\partial P_F} = 1$, then $dP_L = dP_F$.

(5') $\quad dES_L = \frac{\partial ES_L}{\partial P_F} dP_F$

(6') $\quad dM_L = dES_L$

Next, we substitute (1) and (2) into (3) and then substitute (3) and (5) into (6). Then by (4), since $dP_L = dP_F$, we substitute dP_L for dP_F in equation (6). The result is:

(7) $\quad \frac{\partial D_L}{\partial P_L} dP_L + \frac{\partial D_L}{\partial \beta_L} d\beta_L - \frac{\partial S_L}{\partial P_L} dP_L = \frac{\partial ES_L}{\partial P_F} dP_L.$

Gathering terms in dP_L on the right hand side of the equation yields:

(8) $\quad \frac{\partial D_L}{\partial \beta_L} d\beta_L = \left(\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F} \right) dP_L.$

Thus, the effect of lamb promotion on U.S. lamb price is calculated by cross-multiplying in equation (8) to get:

(9) $\quad \dfrac{dP_L}{d\beta_L} = \dfrac{\frac{\partial D_L}{\partial \beta_L}}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} > 0.$

From equation (9) we get the expression for dP_L which we use to calculate the effects of promotion on S_L, D_L, and M_L from equations (1'), (2'), and (3'):

(10) $\quad dP_L = \left[\dfrac{1}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} \right] \frac{\partial D_L}{\partial \beta_L} d\beta_L.$

Then, the <u>effect of promotion on the U.S. supply of lamb</u> is obtained by substituting equation (10) into (1') to get:

(11) $\quad dS_L = \left[\dfrac{\frac{\partial S_L}{\partial P_L}}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} \right] \frac{\partial D_L}{\partial \beta_L} d\beta_L > 0.$

The <u>effect of promotion on the U.S. demand for lamb</u> is obtained by first substituting equation (10) into (2') to get:

$$dD_L = \left[\dfrac{\frac{\partial D_L}{\partial P_L} \cdot \frac{\partial D_L}{\partial \beta_L}}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} \right] d\beta_L + \frac{\partial D_L}{\partial \beta_L} d\beta_L$$

which can be simplified using a common denominator ($\dfrac{\partial S_L}{\partial P_L} - \dfrac{\partial D_L}{\partial P_L} + \dfrac{\partial ES_L}{\partial P_F}$) to get:

$$(12) \quad dD_L = \left[\frac{\frac{\partial S_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} \right] \frac{\partial D_L}{\partial \beta_L} d\beta_L$$

The <u>effect of promotion on lamb imports</u> is obtained by substituting (11) and (12) into (3'):

$$dM_L = \left[\frac{\frac{\partial D_L}{\partial \beta_L} \left(\frac{\partial S_L}{\partial P_L} + \frac{\partial ES_F}{\partial P_F} \right)}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} - \frac{\left(\frac{\partial S_L}{\partial D_L} \right) \left(\frac{\partial D_L}{\partial \beta_L} \right)}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} \right] d\beta_L$$

which simplifies to:

$$(13) \quad dM_L = \left[\frac{\frac{\partial ES_F}{\partial P_F}}{\frac{\partial S_L}{\partial P_L} - \frac{\partial D_L}{\partial P_L} + \frac{\partial ES_L}{\partial P_F}} \right] \frac{\partial D_L}{\partial \beta_L} \cdot d\beta_L.$$

Equations (10) through (13) are then used to conduct a counter-factual simulation analysis of the changes in U.S. lamb production (dS$_L$), demand (dD$_L$), price (P$_L$), and imports (dM$_L$) from a change in the level of promotion expenditures. As indicated in equations (10) – (13), several parameters are required for the simulation:

(a) The slope of the lamb supply curve ($\frac{\partial S_L}{\partial P_L}$) from 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 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 the price elasticity of lamb import supply: $\frac{\partial ES_F}{\partial P_F} \frac{P_F}{D_F}$;

(d) The slope of the lamb demand with respect to promotion ($\frac{\partial D_L}{\partial \beta_L}$) which can be calculated from the promotion elasticity: $\frac{\partial D_L}{\partial \beta_L} \frac{\beta_L}{D_L}$; and

(e) The change in promotion: $d\beta_L$.

The parameters from (b) and (d) are provided by the econometric estimation of U.S. lamb demand, the results of which are presented later. The change in promotion from (e) is the level of promotion expenditures in each year of the sample period. That is, the simulation assumes that zero expenditures were made over the period of analysis. The parameter in (c) can be calculated from the work of Ghosh and Williams (2014) or we can use a range of plausible assumed elasticities. For the parameter of lamb supply from (a), we can also assume a range of plausible elasticities. 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.

To econometrically estimate the required lamb demand elasticities with respect to price $(\frac{\partial D_L}{\partial P_L}\frac{P_L}{D_L})$ and lamb promotion expenditures $(\frac{\partial D_L}{\partial \beta_L}\frac{\beta_L}{D_L})$, equation (2) of the lamb industry model is operationalized as follows in which the L subscript for lamb is dropped:

(14)   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:

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

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 (15) 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 (14) 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 Ghosh and Williams 2016). 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 (15)) 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.

Counter-Factual Simulation Analysis Process

The first objective of this study as discussed earlier is to answer the question: What have been the effects of the American Lamb Checkoff Program on U.S. lamb markets and imports? To answer that question, we use the U.S. lamb demand model represented in equations (1) through (6) (by means of equations (10) – (13)) to conduct a counterfactual simulation analysis over various time periods. 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 the simulation period because this scenario assumes that the checkoff promotion expenditures to enhance U.S. lamb demand were made as actually occurred over time. The *without promotion* scenario assumes that the checkoff promotion expenditures were <u>not</u> made as actually occurred over time. In other words, the counter-factual simulation assumes that the lamb checkoff program did not exist over the simulation period. Thus, to conduct the *without promotion* counter-factual scenario, lamb checkoff promotion expenditures are set to zero in every year of the simulation in equations (10) – (13) and the resulting levels of lamb production, demand, price, and imports are calculated. The simulation produces levels of U.S. lamb production, demand, price, and imports <u>that would have existed if there had not been any expenditures over time to promote lamb demand</u>. The differences between the levels of lamb production, demand, price, and imports over time 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 time 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 export 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 of the sample period.

For the lamb supply elasticity (the parameter listed (1)), a range of plausible elasticities can be 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. From the work of Ghosh (2014), the long-run price elasticity of U.S. lamb supply can be calculated as 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 foreign export supply of lamb, 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 assume a more plausible range for the Australia/New Zealand lamb export supply elasticity 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 from foreign suppliers, four separate simulations were conducted with four combinations of assumed price elasticities of U.S. lamb supply and foreign export supply of lamb to the U.S. (see Table 1). Simulation 1 assumes that both the U.S. and foreign export 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 export supply at a lower bound of 1.0.

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

| Assumed Long-Run Elasticity of:	Simulations (Alternative Elasticity Assumptions)			
	1	**2**	**3**	**4**
	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

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 by answering the question: What have been 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 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 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

Figure 2: Returns to the Lamb Industry from Lamb Demand Promotion
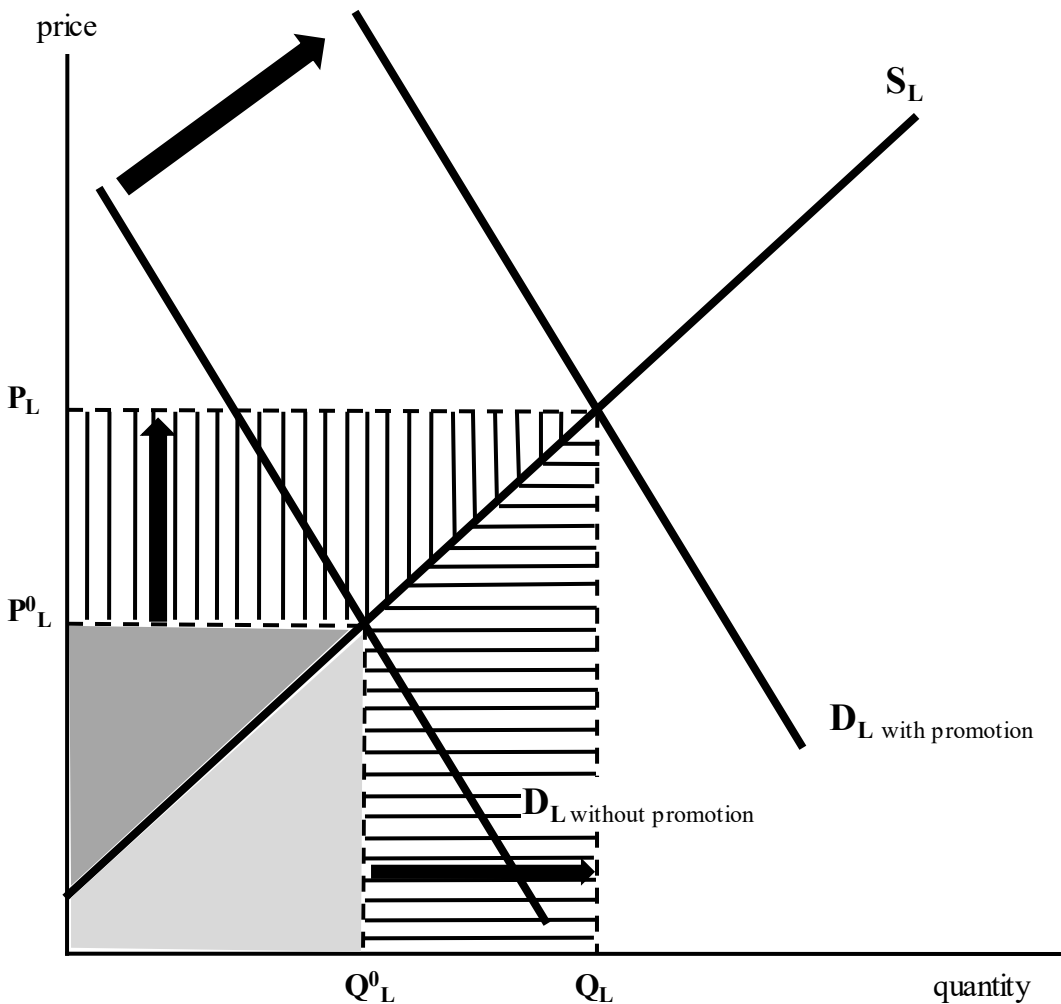
demand curve raise price. In raising the price, however, they also stimulate a greater level of production over time than would have occurred which moderates the extent of the price increase.

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 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 without promotion to D_L 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 without promotion to D_L 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 without promotion to D_L 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^L_i) 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 without promotion to D_L with promotion) and, thus, a larger positive effect on farm profits (represented by the light red area in Figure 3).

Figure 3: Returns to the Lamb Industry from Lamb Demand Promotion with Different Lamb Supply Elasticities
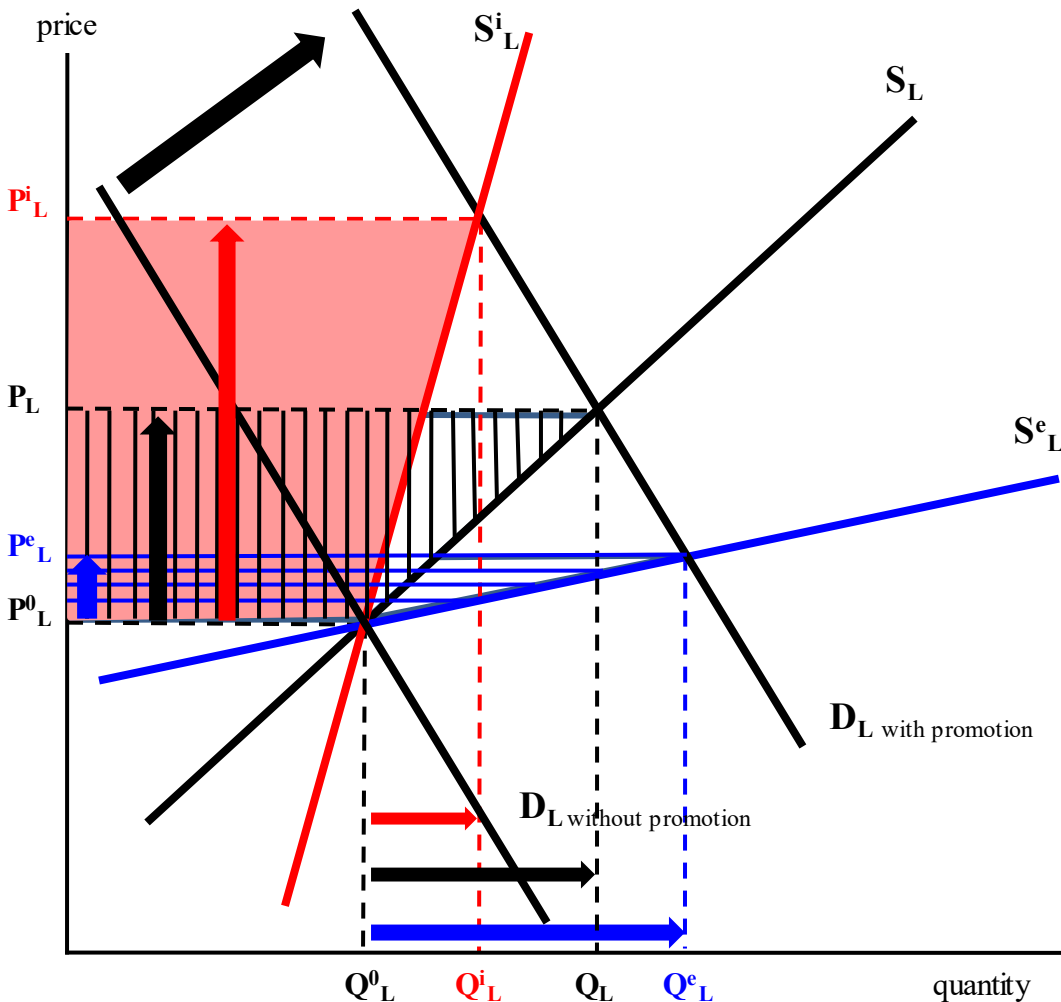
Thus, the extent of the increase in farm profits from a promotion-induced increase in demand depends on the responsiveness of supply to price over time (i.e., the long-run price elasticity of supply). For that reason, the counter-factual analysis considers a range of U.S. supply elasticities to determine 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. To compare the returns to the U.S. lamb industry from promotion before and after the establishment of the current mandatory lamb checkoff program, we conduct the four simulations over the 1979/80-2017/18 time period and calculate the market effects and BCRs over two time periods: (1) the pre-American Lamb Board period of 1979/80-2002/03 and (2) the ALB checkoff promotion period of 2003/04-2017/18. The results give some insight into the effectiveness of the current lamb checkoff program relative to promotion conducted in pre-ALB years.

Two BCRs are calculated in this study for each of the four simulation scenarios conducted for the period of the current lamb checkoff program promotion under ALB and for the pre-ALB period: (1) the Net Revenue BCR (NBCR) and (2) the net economic surplus or profit BCR (SBCR). The NBCR is calculated as the additional lamb industry 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:

$$(16) \quad NBCR = \sum_{t=1}^{T} \frac{R_t - E_t}{E_t} \ .$$

The SBCR is calculated by replacing the R (the industry revenue earned) in equation (17) with the additional economic surplus (profit) earned by the industry as a result of the promotion (S) calculated as discussed above:

$$(17) \quad SBCR = \sum_{t=1}^{T} \frac{S_t - E_t}{E_t} \ .$$

The BCRs provide measures of the net revenue (equation (16)) or the profit (equation (17)) earned by the U.S. lamb industry per dollar of expenditure by the ALB on lamb promotion. For the purposes of checkoff program evaluations, a BCR of greater than 1.0 is taken as an indication that the promotional efforts have benefited stakeholders because stakeholder benefits (net revenue and/or profit) increase by more than one dollar for every dollar spent on promotion over the period of analysis. On the other hand, a BCR 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 (net revenue or profit) over time.

Economic Contribution Analysis Methodology

The economic contribution analysis presented in this report focuses particularly on the contribution of the additional net revenues to the lamb industry from additional lamb

consumption as a result of promotion over the history of the current lamb checkoff program (2003/04 – 2017/18) to the value of U.S. output, value added, employment, labor income, and taxes paid (federal, state-level, and local) over that period. This study first measures the direct, indirect, and induced effects of the additional value of U.S. lamb consumption from promotion on the U.S. economy. The *direct effects* on the economy are the initial economic activities stimulated by the aggregate additional net value of the lamb consumed as a result of ALB promotion expenditures over 2003/04 through 2017/18. The direct effects are like the splash of a rock into water. That splash results in two types of secondary effects like the ripples of water following the initial splash from the rock: (1) *indirect effects* and (2) *induced effects*. The indirect effects result from the purchase of inputs among local industries as a result of the additional sales of lamb generated by the promotion expenditures. The induced effects result from the expenditures by institutions such as households and governments that benefit from increased activity among local businesses (IMPLAN 2016a).

The general methodology is based on the idea that a dollar spent in an economy stimulates additional economic activity or multiplies as it circulates through the entire economy. To estimate the national economic contribution of the additional lamb industry revenue from lamb promotion expenditures, we use the IMPLAN (IMpact analysis for PLANning) input-output system (IMPLAN 2016b). Input-output analysis is based on the idea that a change in one sector of the economy has effects on other sectors of the economy. Input-output analysis captures the relationships between industries along backward linked supply chains 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.

To measure the impacts on the economy of any change in economic activity, the IMPLAN model produces multipliers which estimate the total economic contribution of expenditures within an economy. Multipliers are calculated based on the purchasing patterns of industries and institutions in the regional economy. Each industry and region combination has a unique spending pattern and a unique multiplier relating to the direct, indirect, and induced effects of the spending.

Four types of economic effects are reported in 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 and indicates a benefit to local residents. The **value-added** measures the contribution to gross domestic product and indicates the return to resources used by the business. The **output** contribution measures economic activity (total spending) generated. Labor income is a subset of value-added which is part of output. These three effects provide a better perspective of the contribution of an economic activity but they are three separate views and not meant to be summed.

In this particular analysis, the initial injection of additional revenue into the economy is considered to occur at the retail level given that most of those expenditures actually occur at that level. Thus, in this analysis, the indirect effects include the additional purchases of inputs by retail businesses back through the supply chain as a result of the initial injection of additional revenues with the induced effects accounting for the additional economic activity generated at the retail level. The analysis essentially considers the multiplier effects of the additional retail spending on lamb as a result of retail promotion along the supply chain from retailers back to farms and farm suppliers. While measuring the multiplier effects all along the supply chain from the promotion investment, the IMPLAN methodology does not consider the possibility of substitution between commodities as a result of promotion. At the same time, however, any compensating complementary or halo effects are also not considered.[1]

The first step in the economic contribution analysis process was to develop an IMPLAN input-output model of the U.S. economy. The IMPLAN software and the 2016 IMPLAN data were used to create multipliers for the U.S. model. By constructing social accounts that describe the structure and function of a specific economy, IMPLAN creates a model to investigate the consequences of projected economic transactions in a geographic region (IMPLAN 2016c).

With the U.S. models constructed, the next step in the process was to determine the sector or sectors in IMPLAN to use for the analysis. IMPLAN consists of 536 different sectors from production to transportation, wholesale, manufacturing, retail, services and others. Then, an "industry change" activity was selected for the IMPLAN sector or sectors chosen.

Next, the additional net retail value of lamb consumption generated by the lamb promotion expenditures was distributed (or margined) across the respective industries or sectors of the value chain (producer, transportation, processing, wholesale, retail). The calculated values of increased aggregate retail revenues from lamb consumption for 2003/04 to 2017/18 were then entered as the industry sales for the chosen events within the respective U.S. retail model. The IMPLAN analysis of the contribution of lamb promotion to the U.S. economy at the retail level entailed a calculation of the direct, indirect, and induced impacts of the "industry change" (increased net revenue from lamb consumption) at the respective industry levels.

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-

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[1] A halo effect is the phenomenon whereby the promotion of one commodity positively affects the demand for some other related commodity (see Rusmevichientong and Kaiser 2011).

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.

To consider the effects of the lamb checkoff program in a broader economic context, an economic contribution analysis of the multiplier effects from the U.S. lamb industry to the overall U.S. economy is also conducted using IMPLAN. The results of that analysis provide measures of the aggregate contribution of the lamb checkoff program to the U.S. economy as well as the industry distribution of that contribution.

Econometric Analysis of U.S. Lamb Demand

The econometric analysis of the U.S. demand for lamb as specified in equation (14) utilizes annual historical data for marketing years 1978/79 through 2017/18 (July/June). Data for per capita lamb consumption (D/POP in equation (14)) as well as retail prices for beef, pork, and poultry (P_i in equation (14)) are available from USDA (USDA, 2018). Unfortunately, a consistently reported, reliable time series for the retail price of lamb (P in equation (14)) is not available as discussed in some detail by Shiflett and Marsh (2015). They provide an excellent discussion of the price data and indices available for use in demand analyses. As done by Shiflett and Marsh, 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 organ and meat price index for 2009/10 through 2017/18 from the Bureau of Labor Statistics (USDL, 2018). The composite price index was converted into a retail price series using actual retail prices 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)[2].

Data for personal disposable income (Y), population (POP), and the consumer price index (1982-84=100) (I) were obtained from the Federal Reserve Bank (FRB, 2018). Data for lamb advertising and promotion expenditures since July 2002 when the national lamb checkoff program began operations were provided by ALB (ALB, 2018b). Lamb promotion expenditures over the pre-mandatory checkoff period of 1978/79 through 2001/02 were provided by ASIA (2010).

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[2] Retail lamb price data are no longer available from LMIC.

To provide both a test of the robustness of the econometrically estimated parameters of the lamb demand equation (14) and a comparison of the effectiveness of lamb promotion programs before and after the establishment of the current mandatory lamb checkoff program, we first estimated the parameters of equation (14) over the pre-ALB period of 1978/79 to 2002/03. The results are in Table 2. Then the data for the period of the current mandatory checkoff program under the ALB (2003/04 to 2017/18) were added to the model and the parameters re-estimated. The results are provided in Table 3. The regression statistics at the bottom of each table indicate that both equations are excellent fits of the data with high R-squares of around 98%. Thus, the two models explain about 98% of the changes in lamb demand over the respective time periods. In addition, the statistics indicate a lack of error correlation with Durbin-Watson (DW) statistics just above 2.0 and low Durbin-h statistics.

A comparison of the results of estimating the lamb demand model over the pre-ALB period (Table 2) and then adding the additional 16 years of data for the current checkoff program under ALB (Table 3) indicates that the parameter estimates are quite robust. The real retail price of lamb is statistically significant in both models. The lamb demand price elasticity for the full 1978/79 to 2017/18 period (-0.5852) is only slightly lower than estimated for the earlier period of 1978/79 to 2001/02 (-0.6412). Both results are highly consistent with those of the previous lamb ROI study (Ghosh and Williams, 2014 and 2016) and with those of other previous lamb demand studies (see Shiflett and Marsh, 2015). These results suggest that U.S. lamb demand is not highly responsive to price changes (price inelastic) and that lamb demand price responsiveness has declined in recent years. A 10% increase in the price of lamb leads to about a 6% decline in the demand for lamb.

Also, the results indicate that lamb demand is inelastic with respect to changes in the price of beef. Compare the estimated price elasticities for beef in Tables 2 and 3. Those results suggest that a 10% change in the price of beef results in about a 5% decline in the quantity of lamb demanded. In contrast to beef, the significance of the price of pork in explaining changes in the demand for lamb is found to have declined between the two time periods. In the pre-ALB promotion period, the real retail price of pork is statistically significant at the 10% level (Table 2). In the full period model, however, the real retail price of pork becomes statistically insignificant as a driver of lamb demand (Table 3). The parameter estimate for the real pork price in the two models is substantially lower than for either lamb (absolute value) or beef. The previous lamb ROI analysis found the pork price to be a statistically significant driver of lamb demand. However, the results from previous lamb demand analyses regarding the magnitude of the estimated coefficients and the significance of the retail price of pork as a driver of lamb demand are quite inconsistent (Shiflett and Marsh, 2015). Most of those studies have concluded that the retail price of pork has had little or no effect on the demand for lamb (Shiflett and Marsh, 2015).

We initially included the real price of broilers as a potential driver of lamb demand as well. The result was no statistical significance of that price in ether of the models. The implication is that

Table 2: Econometric Results for the U.S. Per Capita Demand for Lamb, 1978/79 – 2002/03

Dependent variable: Per capita lamb consumption				
Variables (in natural logs except indicator variables)	Estimate	Standard Error	t Value	P-Value
Intercept	0.7791	1.4366	0.54	0.5995
Real retail price of lamb (P/I)	-0.6412	0.1882	-3.41	0.0067
Real retail price of beef (P_B/I)	0.5224	0.1622	3.22	0.0092
Real retail price of pork (P_P/I)	0.1921	0.0986	1.95	0.0798
Real per capita disposable personal income (Y/POP/I)	0.0565	0.1705	0.33	0.7471
Lagged per capita lamb consumption $(D/POP)_{t-1}$	0.4551	0.1397	3.26	0.0086
High lamb availability in 1985 (DHIGH85)	0.0396	0.0253	1.57	0.1478
Low lamb availability in 1994 (DLOW94)	-0.0483	0.0243	-1.99	0.0750
Transition from Wool Incentive Program in 1997 (DWOOLT)	-0.0739	0.0279	-2.65	0.0243
Years of no checkoff in 1998 and 1999 (DNOCHECK)	-0.1099	0.0440	-2.50	0.0317
Years of 201 assistance payments in 2000 and 2001 (D201ASST)	0.1073	0.0476	2.26	0.0477
Goodwill Variable for Lamb Promotion Expenditures (G)				
Real lamb promotion expenditures in current period (G_t)	0.005363	0.002372	2.26	0.0473
Real lamb promotion expenditures lagged one period (G_{t-1})	0.007150	0.003162	2.26	0.0473
Real lamb promotion expenditures lagged two periods (G_{t-2})	0.005363	0.002372	2.26	0.0473
Regression statistics: Adj. R^2 = 0.9844 DW = 2.1677 Durbin-h = -0.6400				

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 also highly consistently with those of other published lamb demand analyses. As a result, the retail price of broilers was dropped from the final lamb demand model.

As with nearly all studies of the demand for lamb (see Shiflett and Marsh, 2015), we also find that real (deflated) per capita income (Y/POP/I) was not a statistically significant driver of the demand for lamb in either the pre-ALB period or when the 15 years of the data for the current ALB checkoff program are added to the model.

Table 3: Econometric Results for the U.S. Per Capita Demand for Lamb, 1978/79 – 2017/18

Dependent variable: Per capita lamb consumption				
Variables (in natural logs except indicator variables)	Estimate	Standard Error	t Value	P-Value
Intercept	0.8788	0.8853	0.99	0.3312
Real retail price of lamb (P/I)	-0.5852	0.1345	-4.35	0.0002
Real retail price of beef (P_B/I)	0.5244	0.1346	3.90	0.0007
Real retail price of pork (P_P/I)	0.1548	0.1379	1.12	0.2732
Real per capita disposable personal income (Y/POP/I)	0.0694	0.0962	0.72	0.4780
Lagged per capita lamb consumption (D/POP)$_{t-1}$	0.3381	0.1015	3.33	0.0029
High lamb availability in 1985 (DHIGH85)	0.0532	0.0352	1.51	0.1439
Low lamb availability in 1994 (DLOW94)	-0.0619	0.0370	-1.67	0.1080
Transition from Wool Incentive Program in 1997 (DWOOLT)	-0.0483	0.0400	-1.21	0.2390
Years of no checkoff in 1998 and 1999 (DNOCHECK)	-0.1012	0.0561	-1.81	0.0841
Years of 201 assistance payments in 2000 and 2001 (D201ASST)	0.0952	0.0493	1.93	0.0658
Low lamb import availability from Australia/NZ (DAUNZ11)	-0.1374	0.0388	-3.54	0.0017
Consumer resistance to high price behavior (DRESIST13)	-0.1146	0.0465	-3.14	0.0046
Goodwill Variable for Lamb Promotion Expenditures (G)				
Real lamb promotion expenditures in current period (G_t)	0.006503	0.003153	2.06	0.0507
Real lamb promotion expenditures lagged one period (G_{t-1})	0.008671	0.004205	2.06	0.0507
Real lamb promotion expenditures lagged two periods (G_{t-2})	0.006503	0.003153	2.06	0.0507
Regression statistics: Adj. R^2 = 0.9749 DW = 2.1093 Durbin-h = -0.4724				

Following the practice of previous lamb demand studies (Shiflett and Marsh, 2015), the lagged dependent variable (D/POP$_{t-1}$) was included as a regressor in both lamb demand models 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. In our analysis, the relatively low estimated coefficients for lagged per capita lamb consumption (0.4551 for the pre-ALB promotion period model in Table 2 and 0.3381 for the full time period model in Table 3) indicate that lamb consumers adjust their lamb consumption from one period to the next rather quickly. However, comparing the results suggest that the speed of adjustment has slowed since the 1978/89-2001/02 period implying a greater degree of habit persistence among current lamb consumers in recent years.

A number of indicator variables were included in the two models to account for specific events that have affected lamb consumption over the years that are not captured by the other regressors in the model. The lamb consumption data from USDA is, in fact, disappearance data meaning that it is calculated as the residual between lamb supply (production plus imports) and other demand components (change in stocks and exports). Because there are few lamb stocks or exports, the availability of supply has an important influence on the measure of lamb "consumption." The indicator variables DHIGH85 and DLOW94 included as explanatory variables in both models account for the effects of two such supply change events that affected the availability of lamb for consumption (Tables 2 and 3). DHGH85 represents a year of relatively high lamb supply (1985) but is not highly significant statistically in either model. DLOW94 accounts for a lamb supply shortage in 1994 which is statistically significant at the 10% level in both models.

In addition, DWOOLT represents the year in which the Wool incentive payment program was eliminated (1997) and the transition of the industry to no lamb promotion program. DNOCHECK represents the years 1998 and 1999 when there was no checkoff program in place. The results for both variables indicate that demand tended to decline with the elimination of lamb promotion expenditures in those years. While statistically significant in the pre-ALB promotion period (Table 2), DWOOLT turns statistically insignificant when the additional 15 years of data for the period of the mandatory checkoff are added (Table 3). The coefficients for D201ASST in the two models indicate that the 201 assistance payments in 2000 and 2001 had positive and statistically significant impacts on lamb demand in those years.

In the model for the full sample period of 1978/79 through 2017/18 (Table 3), two additional indicator variables were added to the model. DAUNZ11 represents the effects of a world-wide shortage of lamb in 2010/11 on the availability of lamb to U.S. consumers (USDA, 2013). Drought affected Australian production and a large storm killed as many as a million lambs in New Zealand in September 2010. 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). Both variables have the expected negative signs and are statistically significant.

Lamb promotion expenditures are found to be a statistically significant driver of lamb demand in both models. The short-run promotion elasticity of U.S. lamb demand is estimated to be 0.0065 over the full period of 1978/79-2017/18 (coefficient of the variable G_t in Table 3). The medium-run promotion elasticity over that period is estimated to be 0.022 (the sum of the coefficients of G_t, G_{t-1}, and G_{t-2} in Table 3). The long-run promotion elasticity is 0.03275 (the medium-run elasticity divided by one minus 0.3381, the coefficient of the lagged dependent variable). The estimated long-run elasticity is consistent with the long-run promotion elasticity reported in the previous ROI analysis for the lamb checkoff program of 0.037 (Ghosh and Williams, 2014). Thus, the statistical results indicate that a doubling of lamb promotion expenditures (that is, a 100% increase) would result in a 3.275% increase in per capita lamb consumption over the long-run.

In the pre-ALB period analysis for 1978/79 to 2001/02 (Table 3), the long-run lamb promotion elasticity was estimated to be an almost identical 0.0328. Although the short- and medium-run promotion elasticities are smaller for the pre-ALB lamb promotion period, the coefficient of the lagged dependent variable is larger leading to about the same level of promotion elasticity over the long-run in the two models. These estimated lamb promotion elasticities are consistent with those reported for other checkoff commodities (Williams, Capps, and Hanselka, 2017).

Simulation Analysis of the Lamb Checkoff Program

Using the U.S. lamb demand model developed in the methodology section and the price and promotion elasticities from the econometric model of U.S. lamb demand, 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 years. The four simulations correspond to the 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 at their upper bounds (highest plausible levels of 5.0 and 2.0, respectively);

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

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

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

The results of the four simulations are shown in Table 4. The salient result is the 2.4% to 2.7% lift ($62.2 million to $70.3 million) in the retail value of lamb consumption over 2003/04 to 2017/18 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 in the indicated variables over the corresponding years. In other words, between 2.4% and 2.7% of the annual average retail value of U.S. lamb consumption between 2003/04 and 2017/18 is the direct result of the promotion efforts of the American Lamb Board. 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 1.5% to 1.9%) and a more modest lift in the retail lamb price (0.5% to 1.3% on average) over 2003/04 to 2017/18 (Table 4).

The price lift during that period stimulated a lift in U.S. lamb production of about 1% to 2.8% and a smaller 0.6% to 1.9% lift in lamb imports which muted the price response to the promotion somewhat (Table 4). 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), 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 of 5.0 (Table 4). 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 reflect the most plausible results. For that simulation, the 4.69 million lb (2.8%) lift in U.S. lamb production from promotion over the 2003/04 through 2017/18 period is substantially larger than the 1.06 million lb (0.6%) lift in U.S. lamb imports over that period as a result of ALB promotion (Table 4). As a result, the U.S. production share of total U.S. lamb consumption is also higher by 0.5%. 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).

Note also that the lifts in U.S. lamb production, consumption, and price achieved by the American Lamb Board promotion programs (2003/04 - 2017/18) were greater than achieved in the pre-ALB period despite the more modest annual promotion funding available to the ALB.

Benefit-Cost Analysis of the Lamb Checkoff Program

The simulation results 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) over the 2003/04 to 2017/18 period, the return to the lamb industry

Table 4: Averge Annual Lift from Promotion, Before and Since ALB Checkoff Program Expenditures Began in 2003/04

	Period of Analysis											
Average Annual Lift* From Promotion In:	**Pre-ALB Promotion (1978/79 -2002/03)**				**ALB Promotion (2003/04-2017/18)**				**All Years of Promotion (1978/79-2017/18)**			
	Simulations (Elasticity Assumptions)**				Simulations (Elasticity Assumptions)**				Simulations (Elasticity Assumptions)**			
	(1) Both at UB	(2) DS at UB ES at LB	(3) DS at LB ES at UB	(4) Both at LB	(1) Both at UB	(2) DS at UB ES at LB	(3) DS at LB ES at UB	(4) Both at LB	(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)	5,462.4	5,643.2	3,340.0	3,649.1	4,056.7	4,686.9	1,575.4	2,121.9	4,935.2	5,284.6	2,678.2	3,076.4
Percent addition	1.8%	1.9%	1.1%	1.2%	2.4%	2.8%	0.9%	1.3%	2.0%	2.1%	1.1%	1.2%
U.S. Consumption (1,000 lb)	5,899.7	5,874.5	4,544.3	4,339.7	5,886.7	5,749.0	5,081.5	4,494.4	5,894.8	5,827.5	4,745.8	4,397.8
Percent addition	1.8%	1.8%	1.4%	1.3%	1.9%	1.9%	1.7%	1.5%	1.9%	1.8%	1.5%	1.4%
Imports (1,000 lb)	437.3	231.3	1,204.4	690.6	1,830.1	1,062.1	3,506.2	2,372.6	959.6	542.9	2,067.5	1,321.4
Percent addition	0.7%	0.4%	1.9%	1.1%	1.0%	0.6%	1.9%	1.3%	0.9%	0.5%	1.9%	1.2%
U.S. Production Share of Consumption (%)	0.0%	0.0%	-0.3%	-0.1%	0.3%	0.5%	-0.4%	-0.1%	0.1%	0.2%	-0.4%	-0.1%
Retail Price (¢/lb)	1.3	1.4	3.8	4.2	4.1	4.7	7.8	10.5	2.3	2.6	5.3	6.6
Percent addition	0.3%	0.4%	1.0%	1.1%	0.5%	0.6%	0.9%	1.3%	0.4%	0.5%	1.0%	1.2%
Value of Consumption ($1,000)	25,571.9	25,646.3	28,862.2	29,445.0	62,168.6	62,985.1	66,785.9	70,262.2	39,295.6	39,648.4	43,083.6	44,751.5
Percent addition	2.1%	2.2%	2.5%	2.4%	2.4%	2.4%	2.7%	2.6%	2.3%	2.3%	2.6%	2.5%

* 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, 2003/04-2017/18**
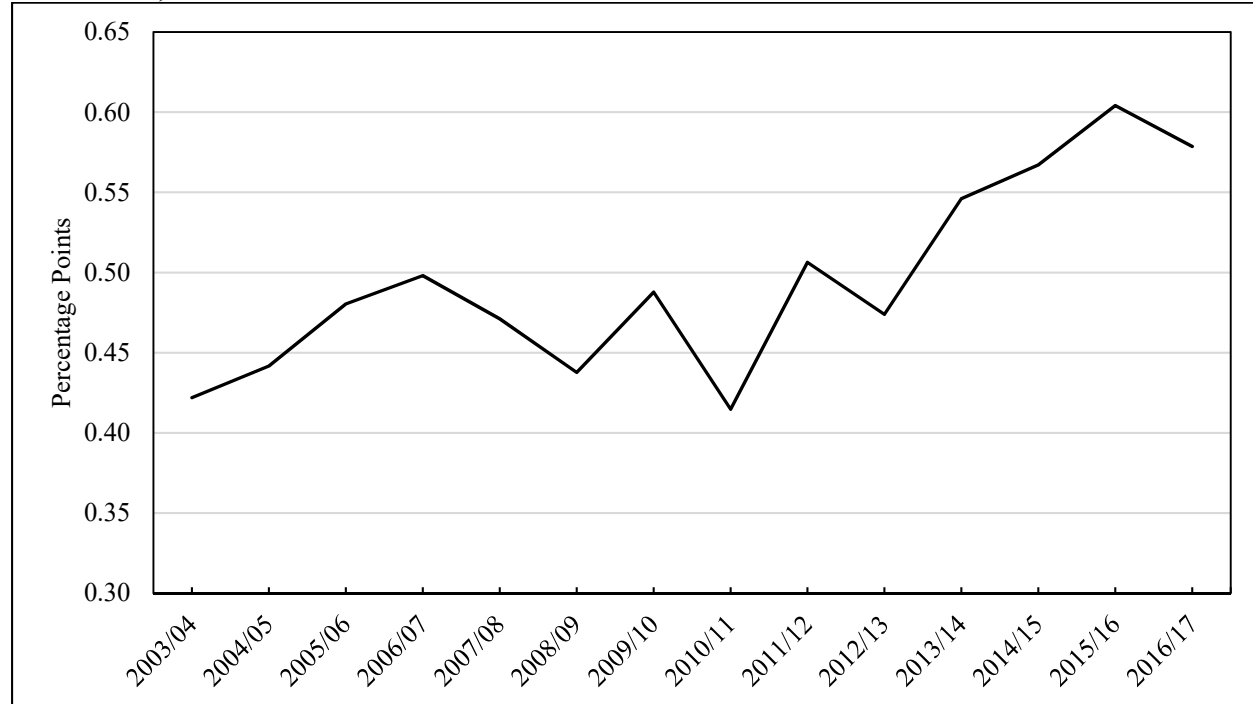
from promotion in terms of additional industry profit ranges from \$14.2 to \$33.4 per promotion dollar (Table 5). The lower end of the range corresponds to higher price responsiveness of the U.S. supply of lamb. Given that U.S. lamb production is likely much more price responsive than the supply of lamb coming from export suppliers as discussed in the methodology section, then the BCR result for simulation 2 of \$14.2 per dollar of promotion most plausibly represents the returns to the U.S. lamb industry from ALB lamb promotion over the 2003/04 to 2017/18 period. That result corresponds closely with the BCR of \$14.44 per dollar of promotion reported in the previous lamb checkoff ROI analysis (Ghosh and Williams, 2014).

Note that the range of the estimated BCRs over the ALB promotion period are much higher than those in the pre-ALB period (Table 5). That result is the consequence of at least two factors. First, the average \$1.56 million spent annually by the ALB on promotion is smaller than the average annual promotion of \$2.24 million under the Wool Incentive Program (1978/79 to 1997/98). The law of diminishing returns suggests that the higher the expenditure on promotion the lower the corresponding BCR. Also, promotion was determined to be more effective during the ALB promotion years than in the pre-ALB years in the econometric analysis reported earlier (see Tables 2 and 3). The greater effectiveness of ALB promotion may be due in part to the focus on retail promotion activities rather than on a broader range of activities as was the case during the Wool Incentive Program promotion years (see Table 1).

Table 5: Lamb Promotion Benefit Cost-Analysis, Before and Since ALB Checkoff Program Expenditures Began in 2003/04

	Period of Analysis											
	Pre-ALB Promotion (1978/79 -2002/03)				ALB Promotion (2003/04-2017/18)				All Years of Promotion (1978/79-2017/18)			
Total Promotion Expenditures ($1,000)	49,795				23,431				73,226			
Historical Retail Value of Lamb Sales ($1,000)	30,451,425				39,556,458				70,007,883			
Chekoff Investment Intensity Ratio*	0.16%				0.06%				0.10%			
	Simulations (Elasticity Assumptions)**				Simulations (Elasticity Assumptions)**				Simulations (Elasticity Assumptions)**			
	(1) Both at UB	(2) DS at UB ES at LB	(3) DS at LB ES at UB	(4) Both at LB	(1) Both at UB	(2) DS at UB ES at LB	(3) DS at LB ES at UB	(4) Both at LB	(1) Both at UB	(2) DS at UB ES at LB	(3) DS at LB ES at UB	(4) Both at LB
Lamb Consumption Value Added by Promotion ($1,000)	639,297	641,159	721,556	736,126	932,528	944,776	1,001,788	1,053,933	1,571,825	1,585,935	1,723,344	1,790,058
Share of consumption value added by promotion	2.1%	2.2%	2.5%	2.4%	2.4%	2.4%	2.7%	2.6%	2.3%	2.3%	2.6%	2.5%
Retail Net Revenue BCR** *	11.8	11.9	13.5	13.8	38.8	39.3	41.8	44.0	20.5	20.7	22.5	23.4
Industry Profit (Economic Surplus) BCR***	2.0	1.7	7.7	7.3	17.1	14.2	33.4	32.7	6.9	5.7	15.9	15.5

* 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.
*** Industry cost of promotion netted out.

Economic Contribution Analysis for the ALB Checkoff program

This analysis considers the overall economic contribution of the additional value of lamb sales generated by the ALB lamb promotion expenditures (the "direct" effects) at the retail level. The additional revenue earned by lamb industry stakeholders from the ALB promotion is the share of the total additional sales value generated at the retail level that is transmitted up the supply chain and captured by those stakeholders. However, others along the supply chain also experience additional business and earn additional revenues as a result of the retail lamb promotion activities. Their spending creates additional economic activity that multiplies through the economy.

In this analysis, therefore, as discussed in the methodology section, the <u>total</u> additional retail value of lamb consumption generated by the ALB promotion program over the 15-yer period of 2003/04 through 2017/18 is taken as the "direct" effect or the initial economic activity. As shown in the preceding analysis, the additional revenue from lamb sales generated by lamb promotion over that period ranged from a low of $932.5 million to a high of $1.054 billion depending on the price elasticities assumed for domestic U.S. lamb supply and the foreign export supply of lamb to the United States (see Table 5). The low end of the range corresponds to simulation 1 in which both elasticities are at their upper bound (5.0 and 2.0, respectively). The high end of the range corresponds to the opposite case in simulation 4 in which both elasticities are at their lower bounds (both at 1.0).

The "indirect" effects result from the purchase of inputs by local industries at each level as a result of the "direct effect" of the additional lamb sales revenues generated by the lamb checkoff program. The "induced" effects result from expenditures of the additional income by households and institutions such as governments that benefit from the increased activity along the various economic supply chains.

The results of the contribution analysis using the IMPLAN model indicates that the aggregate direct, indirect, and induced effects of the $932.5 million to $1.054 billion in increased retail value of lamb consumption resulting from the ALB promotion program over the 15-year period of 2003/04 to 2017/18 generated an aggregate contribution to U.S. output or total spending of between $2.0 billion and $2.3 billion (Table 6). That is, between $2.0 billion and $2.3 billion of the U.S. output (total consumer spending) between 2003/04 and 2017/18 was the direct result of ALB promotion activities during that period. At the same time, the promotion over that period was responsible for generating between $871 million and $984 million of the U.S. GDP (value-added) over that period along with between $534 million and $603 million of the U.S. labor income, and between $192 million and $217 million of the taxes paid (federal, state, and local). In addition, the promotion added an annual average of between 821 and 927 jobs to the economy over that period.

Table 6: National Economic Contribution of the ALB Promotion Program, 2003/04-2017/18

U.S. Output (Sales)	U.S. Value-added (GDP)	U.S. Employment	U.S. Labor Income	U.S. Taxes*
$ million	$ million	no. of jobs	$ million	$ million
$2,006.0 - $2,267.2	$871.4 - $984.8 (0.011-0.012% of GDP)	821 - 927	$533.8 - $603.3	$191.6 - $216.5

* U.S. federal, state, local.

Another metric to measure the national impact of the ALB lamb promotion expenditures is the national contribution generated per dollar of additional value of lamb consumption created by the promotion program. These are the implied national contribution multipliers which indicate the values of U.S. output, U.S. GDP, labor income, and taxes resulting from the ALB lamb promotion activities per dollar of additional value of lamb consumption generated by the promotion. A U.S. employment multiplier is measured as the average number of jobs contributed to the U.S. economy over the 2003/04 to 2017/18 period by the ALB promotion per million dollars in additional value of lamb consumption created by the promotion program.

Calculated in this way, the U.S. output (sales) multiplier of the ALB promotion program is 2.15 meaning that, for every dollar of additional value added to lamb consumption by the ALB promotion program, $2.15 in output (sales) is generated across the U.S. economy (Table 7). This result is the same across all four simulations since IMPLAN produces proportional results for every change in the level of the "direct activity" (increased U.S. lamb value from promotion in this case). The U.S. GDP multiplier of the ALB promotion program is 0.93 and the U.S. labor income multiplier is 0.57. The U.S. employment multiplier indicates that, for every million dollars of additional value of lamb consumption generated by the ALB promotion program, about 1 (0.87) job is created. The U.S. tax multiplier indicates that the additional taxes generated across the U.S. economy as a result of all the economic activity initiated by the ALB lamb promotion program amounted to over 20% of the additional value of lamb consumption added. Thus, for every $1 million increase in the value added to lamb consumption by the ALB promotion program over 2003/04 through 2017/18, U.S. output or spending increased by $2.15 million while GDP increased by $0.93 million, labor income by $0.57 million, employment by 0.87 jobs on average, and U.S. federal, state, and local taxes by $0.205 million.

The national economic contribution analysis results represented in Table 7 can be decomposed into industry components. The industry breakdown reveals that the agriculture, services, and manufacturing sectors account for much of the contribution to U.S. economic activity from the addition to the U.S. lamb sales value generated by ALB promotion activities (Table 8). Together those three industries account for 81% of the contribution of the additional net retail value of lamb consumption to U.S. gross output, 74% of contribution to the U.S. GDP (value-added), 77% of the contribution to U.S. employment, 73% of the contribution to U.S. labor income, and 52% of the

Table 7: Implied National Economic Contribution Multipliers from ALB Promotion, 2003/04-2017/18

U.S. Output (Sales) Multiplier	U.S. Value-added (GDP) Multiplier	U.S. Employment Multiplier	U.S. Labor Income Multiplier	U.S. Tax Multiplier
($ output/$ added revenue)	($ GDP/$ added revenue)	(jobs added/$ million added revenue)	($ labor income/$ added revenue)	(% of added revenue)
2.15	0.93	0.87	0.57	20.5%

* U.S. federal, state, local.

Table 8: Industry Breakdown of National Economic Contribution of ALB Promotion, 2003/04-2017/18

Industry	U.S. Output (Sales)	U.S. Value-added (GDP)	U.S. Employment*	U.S. Labor Income	U.S. Taxes**
	$ million	$ million	no. of jobs	$ million	$ million
Wholesale/Retail	$195 - $220	$130 - $147	120.8 – 136.5	$77 - $87	$23 - $26
Manufacturing	$720 - $814	$126 - $142	68.1 – 77.0	$61 - $69	$7 - $8
Transportation & Warehousing	$107 - $121	$51 - $58	43.9 – 49.6	$39 - $45	$2 - $2
Services	$455 - $514	$282 - $318	200.4 – 226.5	$160 - $180	$18 - $20
- Food & accommodation	$31 - $35	$18 - $20	30.0 – 33.9	$12 - $13	$2 - $2
- Other	$424 - $479	$264 - $298	170.3 – 192.5	$148 - $167	$16 - $18
Agriculture	$448 - $507	$240 - $272	363.1 – 410.3	$170 - $192	$7 - $8
Other	$80 - $90	$42 - $47	24.2 – 27.4	$26 - $29	$3 - $4
Total***	$2,006 - $2,267	$871 - $984	820.5 – 927.3	$534 - $603	$61 - $69

* Annual average over 2003/04 – 2017/18   ** Indirect business taxes.   *** Totals may not add due to rounding.

contribution to U.S. taxes. The wholesale/retail industries are also major beneficiaries, accounting for 10% of the contribution to gross output, 15% of the contribution to GDP, 14% of the contribution to labor income, 15% of the contribution to employment, and 38% of the contribution to taxes. Transportation and warehousing and a large number of miscellaneous services (such as advertising, insurance, accounting and legal service, repair services, and more) account for much of the remaining contribution of the additional lamb sales value from ALB promotion expenditures to the U.S. economy.

CONCLUSIONS AND IMPLICATIONS

This study updates the 2014 analysis of the effectiveness of the American Lamb Checkoff Program (Ghosh and Williams 2014). The primary objective of this study was to answer two related questions: (1) What have been the effects of the American Lamb Checkoff Program on U.S. lamb markets? (2) What have been the returns to the U.S. lamb industry from its investment in the checkoff program (the ROI)?

Although not specifically required as part of this study, the report also considers the economic importance of the lamb checkoff program to the U.S. economy by conducting an economic contribution analysis to answer two additional questions: (1) What has been the contribution of the American Lamb Checkoff Program to the overall U.S. economy? (2) What has been the industry distribution of the contribution of the American Lamb Checkoff Program to the U.S. economy?

An econometric simulation model of the U.S. lamb industry was developed to answer the first two questions, focusing on the effects of the lamb checkoff promotion on U.S. lamb demand, production, imports, and prices. The results of the simulation analysis was 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. To address the additional two questions, we conducted an economic contribution analysis and measured the economic multiplier effects of the additional revenue generated by the lamb checkoff program since the implementation of the program (2003/04 – 2017/18). The process provided measures of the contribution of the lamb checkoff program to the value of U.S. output, U.S. value-added, employment, labor income, and taxes paid (federal, local, and state-level) since the beginning of the effective implementation of the program in 2003/04.

The major conclusions of this study include the following:

- *What Have Been the Effects of the ALB Checkoff Program on U.S. Lamb Markets?*

  To answer this question, we developed a model of the U.S. lamb industry and econometrically estimated the parameters of the U.S. demand for lamb. The econometric results indicate that lamb promotion program has had a statistically significant effect on U.S. lamb demand over the years. Using the model developed and the econometric analysis results, we conducted four separate counterfactual simulations to determine a reasonable range for the changes in U.S. lamb production, consumption, prices, and imports that have occurred over the years as a result of lamb promotion. The four simulations correspond to the likely range of long-run price responsiveness of U.S. lamb production and of foreign export supplies of lamb.

  The salient result was that the promotional activities of the American Lamb Board added between $62.2 million (2.4%) to $70.3 million (2.7%) to the annual value of U.S. lamb consumption on average over the period of 2003/04 to 2017/18 depending on the price

responsiveness of U.S. and foreign lamb supplies. With rather modest funds available for promotion, the ALB succeeded in substantially enhancing the annual value of U.S. lamb consumed over that period. 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 1.5% to 1.9% and a more modest addition to the retail lamb price of 0.5% to 1.3% on average over 2003/04 to 2017/18. The higher price during that period stimulated a higher level of both U.S. lamb production by about 1% to 2.8% and lamb imports by a smaller 0.6% to 1.9% which muted the price response to the promotion somewhat.

- *What Has Been the Return to the U.S. Lamb Industry from Lamb Promotion?*

  Based on the simulation results, a reasonable range for the benefit-cost ratio (BCR) from lamb promotion was calculated for the assumed likely range of price responsiveness of U.S. lamb production and of foreign export supplies of lamb. The results indicate that the return to the lamb industry from promotion in terms of additional industry profit ranged from $14.2 to $33.4 per promotion dollar over the lamb checkoff program years under ALB of 2003/04 to 2017/18. Given that U.S. lamb production is likely much more price responsive than the supply of lamb coming from export suppliers (see methodology section), then the most plausible estimated BCR for the ALB lamb promotion period of 2003/04 to 2017/18 is $14.2 per dollar of promotion. That result corresponds closely with the BCR of $14.44 per dollar of promotion reported in the previous lamb checkoff ROI analysis.

- *What Has Been the Contribution of the ALB Checkoff Program to the U.S. Economy?*

  The results of the contribution analysis using the IMPLAN model indicates that the aggregate $932.5 million to $1.054 billion in additional retail value of lamb consumption resulting from the ALB promotion program over the 15-year period of 2003/04 to 2017/18 made substantial contributions to the U.S. economy, including:
  - » $2.0 - $2.3 billion of U.S. output or total consumer spending;
  - » $871 - $985 million of the U.S. GDP (value-added);
  - » $534 - $603 million of the U.S. labor income;
  - » $192 - $216 million of the taxes paid (federal, state, and local); and
  - » 821 - 927 jobs to the economy on average over the period.

- *What Has Been the Industry Distribution of the ALB Contribution to the U.S. Economy?*

  The industry breakdown of the national economic contribution analysis reveals that:
  - » Agriculture, services, and manufacturing sectors account for 81% of the contribution of the additional net retail value of lamb consumption to U.S. gross output, 74% of contribution

to the U.S. GDP (value-added), 77% of the contribution to U.S. employment, 73% of the contribution to U.S. labor income, and 52% of the contribution to U.S. taxes.

» The wholesale/retail industries account for 10% of the contribution to gross output, 15% of the contribution to GDP, 14% of the contribution to labor income, 15% of the contribution to employment, and 38% of the contribution to taxes.

» Transportation and warehousing and a large number of miscellaneous services (such as advertising, insurance, accounting and legal service, repair services, and more) account for much of the remaining contribution.

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

First, the highly positive BCR calculated for the lamb checkoff program in this study, which is actually much in excess of the BCRs calculated for larger and more mature programs like soybeans, cotton, beef, and pork, does not indicate that the lamb checkoff program is much more effective than those other checkoff programs. Rather, the higher BCR primarily reflects the small size of the lamb checkoff program compared to those of other major commodities, many of which spend in excess of $100 million per year on promotion. Not only is the $1.5 million spent by the lamb checkoff program each year meager by comparison to those larger checkoff programs, the lamb checkoff intensity, that is, the ratio of checkoff expenditures to the value of production, was only 0.06% on average since 2003/04, the first full year of operation of the current lamb checkoff program (see Figure 2), compared to generally 1% to 2% for other checkoff programs. In other words, stakeholders in many other checkoff programs pay more and contribute a much higher share (up to 15 to 30 times higher) of their industry revenues to their respective checkoff programs than do lamb industry stakeholders. Research has shown that as the level of checkoff expenditures grows, the marginal impact of each additional dollar spent declines. Thus, for a huge checkoff program like soybeans, the marginal effectiveness of each dollar is much lower than for lamb which implies a lower average return to each dollar invested under the program. But with $100 million or more being spent, the absolute impact of their checkoff activities on their markets is also much greater.

Second, an implication that follows from the previous implication is that 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 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 $14.2 in 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 increase in in the lamb checkoff assessment rate approved last year will be expected to result in a somewhat lower return to promotion over time. But with such a high estimated BCR, the industry could increase the assessment rate substantially beyond even the

new levels and still expect to generate a quite reasonable rate of return comparable to the $2 to $8 per dollar of promotion earned by the beef, pork, cotton, soybeans, and other checkoff programs.

Third, 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. Nothing could be further from the truth. A BCR of 14:1, for example, results by dividing a $14 billion industry profit benefit by a $1 billion checkoff investment or by dividing a $14 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.

Fourth, because the BCR as a measure of effectiveness is often misunderstood, perhaps the best metric is the share of annual sales that is the result of the checkoff program. In the case of lamb, this study determined that the checkoff program can take credit for between 2.4% to 2.7% of the annual value of lamb consumption, a remarkable achievement with rather modest promotion funds.

Finally, the ALB promotion program not only is enhancing lamb demand at a high ROI, it is also making a substantial contribution to the U.S. economy. The importance of the lamb checkoff program to not only the lamb industry but also to many businesses and people across the nation is a story that could be highly useful in garnering continuing support for the checkoff program by the broader agriculture sector as well as by government entities, and potential, strategic partners along various economic supply chains.

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