EFFECTS OF LAMB PROMOTION ON LAMB DEMAND AND IMPORTS

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Agribusiness, Food, and Consumer Economics Research Center (AFCERC) Commodity Market Research Report No. CM-01-10, January 2010 by Dr. Oral Capps, Jr., Dr. Gary W. Williams, and Ms. Trang Dang.

ABSTRACT

Three key questions regarding lamb promotion are addressed: (1) Have industry efforts to promote lamb shifted out the total demand for lamb? (2) Have any returns to producers achieved been greater than the cost of the promotion? (3) What has been the effect of lamb promotion on the lamb import share? The first question is addressed through an econometric analysis of the U.S. retail demand for lamb which takes into account the effects of lamb advertising and promotion expenditures. The results then are used to calculate a benefit-cost ratio for lamb promotion in answer to the second question. An econometric analysis of the import share of U.S. lamb consumption provides the basis for addressing the third question. Lamb promotion is found to have increased the demand for lamb, and particularly American lamb, generating in the process a highly positive return to producers relative to the small cost of the program.

ACKNOWLEDGEMENTS

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The Agribusiness, Food, and Consumer Economics Research Center (AFCERC) provides analyses, strategic planning, and forecasts of the market conditions impacting domestic and global agricultural, agribusiness, and food industries. Our high-quality, objective, and timely research supports strategic decision-making at all levels of the supply chain from producers to processors, wholesalers, retailers, and consumers. An enhanced emphasis on consumer economics adds depth to our research on the behavioral and social aspects of health, nutrition, and food safety. Through research efforts, outreach programs, and industry collaboration, AFCERC has become a leading source of knowledge on how food reaches consumers efficiently and contributes to safe and healthy lives. AFCERC is a research and outreach service of Texas AgriLife Research and Extension and resides within the Department of Agricultural Economics at Texas A&M University.

EXECUTIVE SUMMARY

The primary objective of this study is to answer three inter-related questions regarding the effectiveness of lamb promotion efforts over the years: (1) Have industry efforts to promote lamb effectively shifted out the demand for lamb? (2) Have the returns to producers from any increase in demand achieved been greater than the cost of the promotion? (3) What has been the effect of lamb promotion on the import share of domestic lamb consumption? In other words, has any increase in U.S. lamb consumption due to promotion come primarily from imports or from domestic production? The first question is addressed through an econometric analysis of the U.S. demand for lamb at the retail level of the marketing channel to isolate and measure the separate demand effects of the main economic determinants of that demand, including advertising and promotion efforts. The results of the analysis then are used to calculate a benefit-cost ratio (BCR) for the program in answer to the second question. An econometric analysis of the import share of U.S. lamb consumption provides the basis for addressing the third key question.

The study concludes lamb promotion over the years has tended to enhance the demand for lamb, generating an impressive return to producers ($44.14 per dollar spent on promotion). At the same time, lamb promotion has tended to switch U.S. consumers from imported to U.S.-produced lamb consistent with the objectives of the current Lamb Checkoff Program. Given the low investment intensity ratio, however, the actual impact of the current Lamb Checkoff Program on the volume of lamb sold is rather small at about 7.9 lbs per dollar spent on

promotion, an increase of less than 4% per year. Past promotion efforts over the 1978/79-2001/02 period were also effective in enhancing lamb demand but at a somewhat lower rate of return to producers. Given the relatively high BCR estimated for lamb promotion, the reduction in promotion expenditures over the last several years translates into a notable opportunity cost to the lamb industry in terms of lost industry revenues. An increase in the assessment rate would generate a large return for every additional dollar of assessment paid by the industry. In other words, for every dollar in additional assessment NOT paid and spent on lamb promotion, the industry loses up to $44.14 in revenue. Research shows that increases in checkoff assessment rates and total spending on promotion are usually accompanied by a reduction in the BCR so that an increase in the lamb checkoff assessment would be expected to result in a lower return to promotion. But with such a high estimated BCR, the industry could increase the assessment rate substantially and still expect to generate a reasonable rate of return comparable to what is earned by the beef, pork, cotton, soybeans, and other similar checkoff programs.

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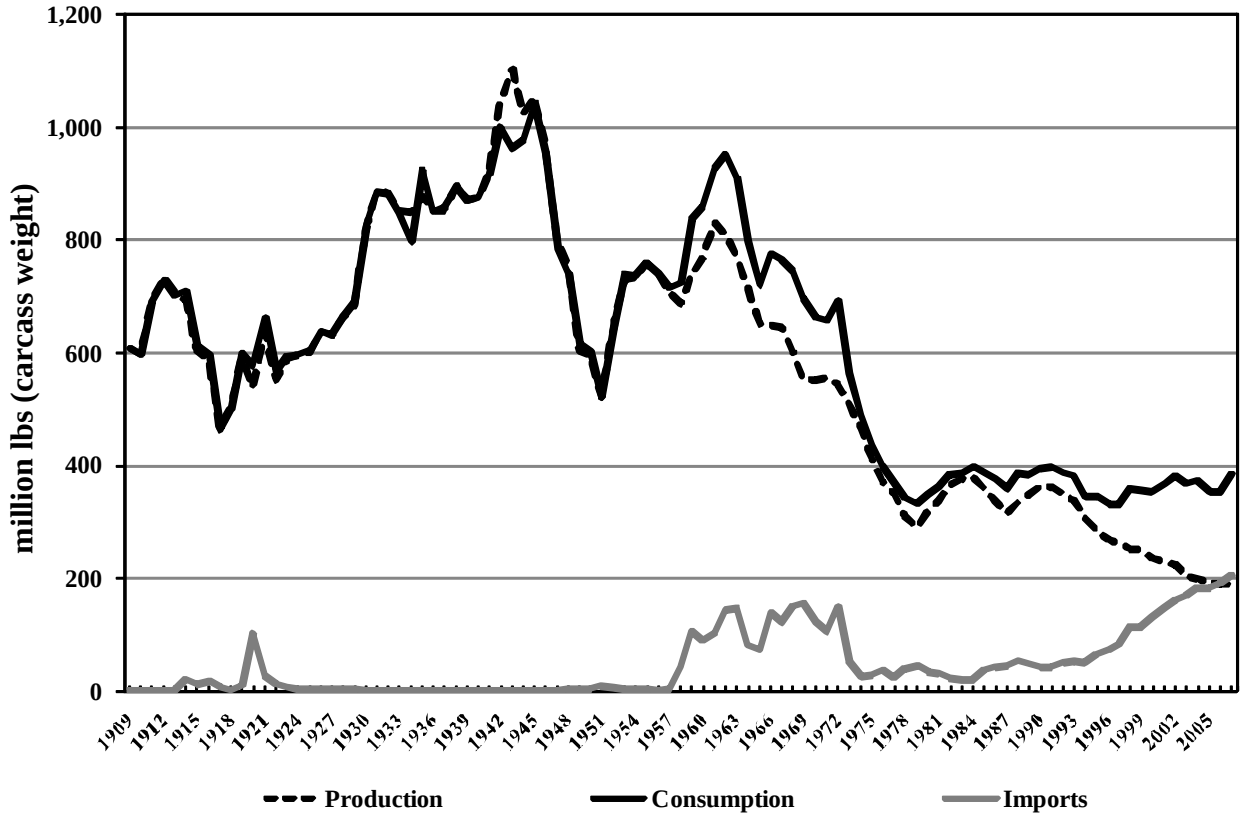
EFFECTS OF LAMB PROMOTION ON LAMB DEMAND AND IMPORTS

The dominant feature of the U.S. sheep and lamb industry and the focus of much producer and policy concern over the years has been the steady decline in sheep and lamb inventories since the mid-1940s. From a record high of 56 million head in 1942, inventories on January 1, 2009 slumped to 5.75 million, the lowest level in recorded history (USDAd, 2009). Declining inventories were accompanied by declining lamb production and consumption until the 1990s when lamb consumption began to stabilize at between 350-400 million lbs even as production continued to slide to under 190 million lbs in recent years (Figure 1). On a retail equivalent basis, per capita lamb consumption has remained at 1.1 lb in most years since 1996. The strength of consumption in the face of declining production has attracted growing imports of lamb, primarily from New Zealand and Australia. Since the mid-1980s, imports have grown from 20 million lbs, about 5% of domestic supply, to over 200 million lbs in recent years, more than half of domestic supply.

Concerns about the shrinking industry and the implications of growing imports have motivated various industry-wide efforts over the years to improve the fortunes of U.S. producers and others along the sheep and lamb supply chain[1]. Most efforts have focused on the supply side of the market through funding production research, mounting legal and political attempts to eliminate inefficiencies of perceived market control by packers and breakers, and cooperative efforts by producers to enhance their competitive market power (Williams and Davis, 1998). Demand-side efforts to deal with shrinking markets and market share began in the 1950s with a modest lamb promotion program operated by the American Lamb Council (ALC) of the Ameri-

[1] See Williams et al. (2008) for a detailed analysis of the major accomplishments and challenges facing the U.S. sheep and lamb industry.

Figure 1. U.S. Lamb Production, Consumption, and Imports, 1909/10-2007/08 (July-June)



can Sheep Industry Association, Inc. (ASIA) (formerly the American Sheep Producers Council) using funds made available under the Wool Incentive Program.

When the Wool Incentive Program and, thus, expenditures for lamb promotion were phased out in 1996/97, an unsuccessful effort was made that year to pass a mandatory checkoff program through a producer referendum. Six years later, following calls by virtually all segments of the domestic sheep and lamb industry for the establishment of a checkoff program to enhance the demand for lamb, the Lamb Promotion, Research, and Information Order, better known as the American Lamb Checkoff Program, was established under the Commodity Promotion, Research and Information Act of 1996. Initiated on July 1, 2002 and operated by the American Lamb Board (ALB), the Lamb Checkoff Program is funded through the assessment and collection of a

fee on all domestic and imported feeder and market lambs and all breeding stock and cull animals when sold. For lambs sold by producers, seedstock producers, exporters, and feeders, the fee is one-half cent ($.005) per pound of live lambs. For lambs purchased for slaughter by first handlers, the assessment is $0.30/head. There is no assessment on imported sheep or lamb products.

The primary objective of this analysis is to answer three key questions regarding the effectiveness of lamb promotion efforts over the years: (1) Have industry efforts to promote lamb effectively shifted out the demand for lamb? (2) Have the returns to producers from any increase in demand achieved been greater than the cost of the promotion? (3) What has been the effect of lamb promotion on the import share of domestic lamb consumption? In other words, has any increase in U.S. lamb consumption due to promotion come primarily from imports or from domestic production? The first question is addressed through an econometric analysis of the U.S. demand for lamb at the retail level of the marketing channel to isolate and measure the separate demand effects of the main economic determinants of that demand, including advertising and promotion efforts. The results of the analysis then are used to calculate a benefit-cost ratio (BCR) for the program in answer to the second question. An econometric analysis of the import share of U.S. lamb consumption provides the basis for addressing the third key question.

LAMB ADVERTISING AND PROMOTION

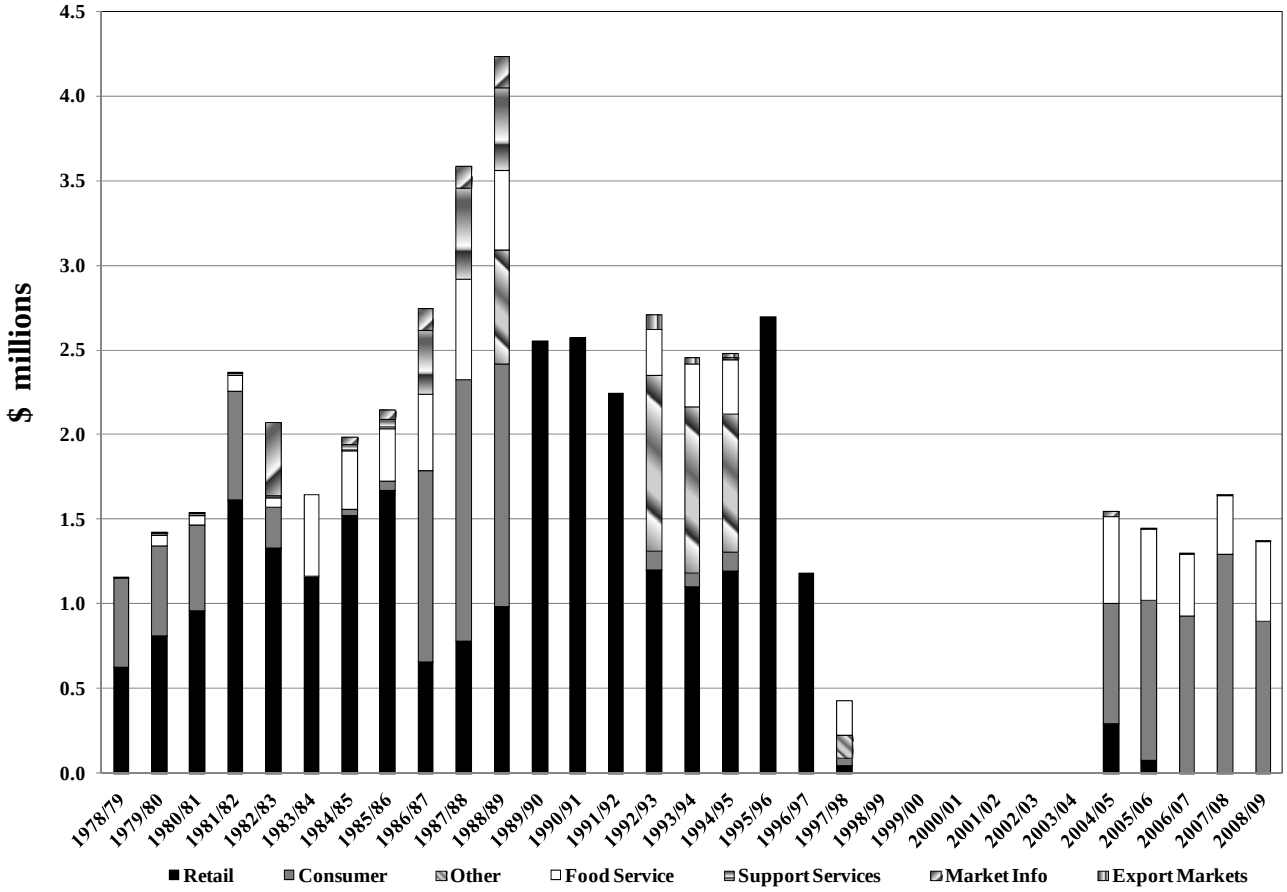
The original lamb advertising and promotion program operated by ASIA was funded by deductions from government payments to lamb producers and feeders under the Wool Incentive Program. Authority for the promotion and advertising deduction from wool incentive payments

was based on a periodic producer referendum under Section 708 of the National Wool Act of 1954. Annual nominal expenditures on lamb promotion activities by ASIA grew from about $1.2 million in 1978/79 to a high of $4.2 million in 1988/89 before declining once again to about $1.2 million in 1996/97 as the phase-out of Wool Incentive Program (WIP) began to take effect. Amendments to the National Wool Act (P.L. 103-130, Nov. 1, 1993) reduced wool and mohair producers subsidies for 1994 and 1995, and terminated the program at the end of 1995 (Canada, 2005).

In the early years, most lamb promotion funds supported 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 broad array of tasks and publicity efforts to communicate directly with lamb consumers and users (newsletters, news releases, photography, and other media/promotional support, etc.); (3) food service promotion (development and placement of advertising with food service establishments, exhibits at culinary promotional events, etc.); and (4) support programs for buyers and merchandisers (tours and staff training, technical and educational services, etc.) (Williams et al., 1991). During the 1990s, however, 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 2).

With the failure of a lamb checkoff referendum vote in late 1996, spending to promote lamb essentially ceased in 1997/98 through 1999/00. In fact, the only funds made available for lamb promotion after the WIP phase-out and the establishment of the current Lamb Checkoff Program in 2002/03 was through a special grant resulting from a 201-trade complaint (Williams et al., 2008). In 1999/00, domestic petitioners alleged injury to the U.S. lamb industry from imports.

Figure 2: Lamb Promotion Expenditures by Category, 1978/78-2008/09*



* No expenditures in 1998/99 and 1999/00 and no breakdown by category available for 2000/01-2003/04.

The U.S. International Trade Commission (ITC) ruled in favor of the domestic complainants. As a result, a lamb import tariff rate quota (TRQ) and a one-time assistance package for the domestic lamb industry were established to remedy the injury and facilitate industry adjustments to import competition. Through this program, $4.8 million in section 201 relief grants for 23 lamb marketing and promotion projects were funded between 2000/2001 and 2002/2003. Much of the funds were allocated to ASIA for three projects related to lamb identification, foodservice promotion, and retail promotion. The remaining funds were allocated primarily to lamb packers, breakers, and processors to promote their lamb products at retail and to foodservice outlets and to develop new lamb products and markets.

Since the inception of the current Lamb Checkoff Program in July 2002 through 2008/09, the ALB has spent a total of about $10.3 million on lamb advertising and promotion, an average of about $1.5 million per marketing year (July-June), about 34% less than the average $2.2 million per year spent by ASIA. Administrative costs are currently limited to a maximum of 10% of collections in any fiscal year so that most of the collected checkoff funds are used for promotional purposes.

The primary stated objective of the Lamb Checkoff Promotion is to increase U.S. lamb industry profits by increasing the demand for American lamb (ALBb, 2009). That is, the program intends to operate more as a branded program in promoting "American" lamb than as a generic program that simply promotes greater lamb consumption. Consequently, success by the Lamb Checkoff program must be measured not just in terms of whether or not lamb promotion activities shift out the demand for lamb and generate a positive benefit-cost ratio but also in terms of its effects on the share of U.S. lamb consumption accounted for by domestic versus imported lamb.

In contrast to the ASIA, the ALB has chosen to allocate most of its promotion funding to consumer relations and food service activities rather than to retail marketing and promotion. Consumer relations has accounted for an increasing share of ALB promotion expenditures from about 45% in 2004/05 to just under 80% in 2007/08 and 65% in 2008/09 (see Figure 2). A large part of ALB activities in this category include print and broadcast media coverage of lamb chefs ("lambassadors") and other media tactics such as satellite media tours, full color feature pages for local newspapers, media kits, and more.

Food service activities now account for almost all the remainder of ALB promotion expenditures and focus on educating chefs and culinary students about the benefits of American

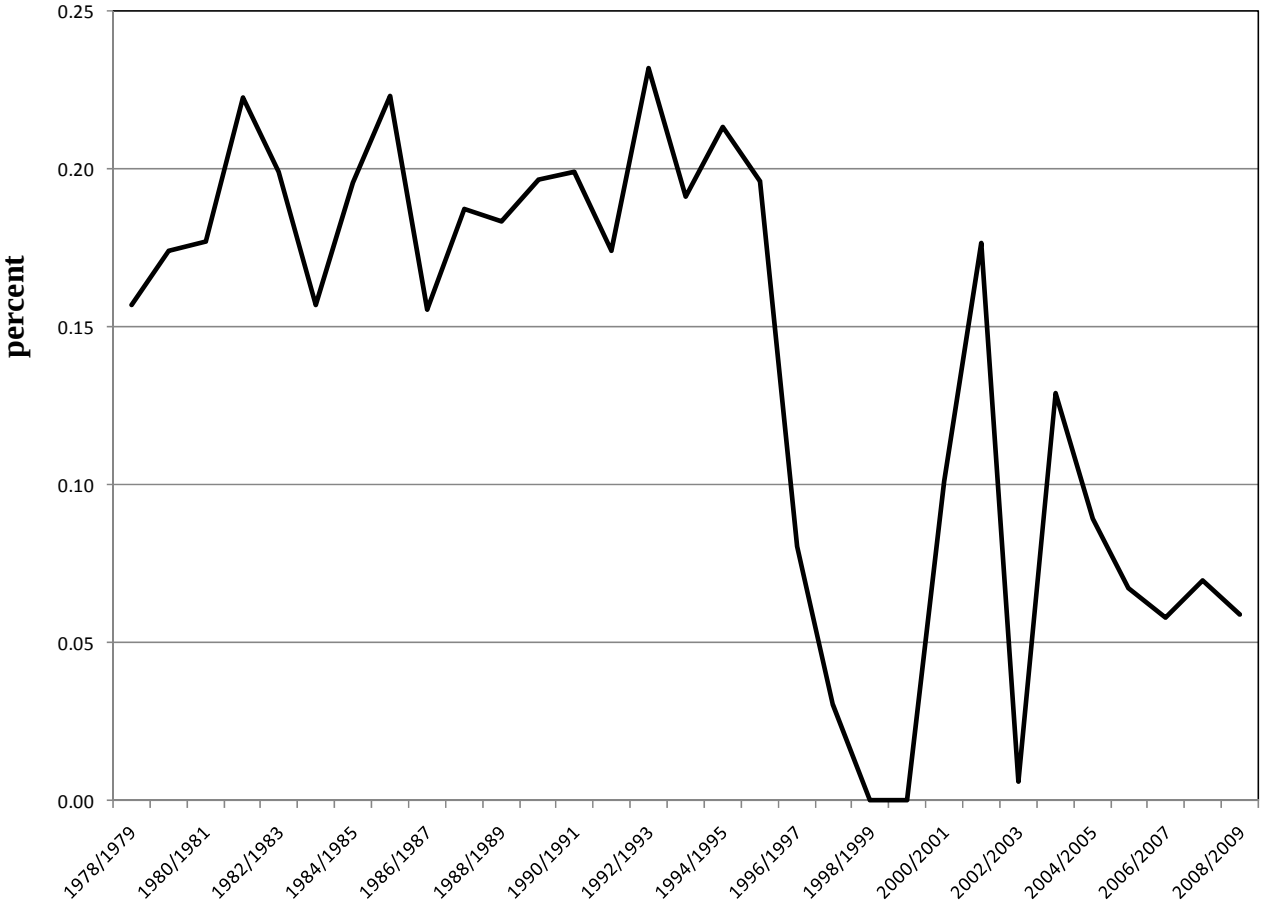
lamb through publicity, participation at major culinary promotional events, and the distribution of culinary educations tools such as sales sheets, fabrication videos, “how to” materials, and an electronic foodservice newsletter that is distributed quarterly to chefs and culinary educators.

Compared to the value of lamb purchases by consumers each year, the amount of funds that the lamb checkoff program collects for the promotion of lamb is extremely small. The annual lamb advertising-to-sales ratio (often referred to as the investment intensity ratio) over the 1978/79 to 2007/08 period ranged from a minimum of zero in 1999/2000 and 2000/01 to a high of 0.23% in 1992/93, averaging 0.19% between 1978/79 and 1995/96 but only 0.07% since the current Lamb Checkoff Program was established (Figure 3). At no more than about one quarter of 1% of the value of lamb sales in any year, the amount of checkoff funds spent to promote lamb consumption each year has been much less than is the case for most of the major checkoff program commodities like beef, pork, soybeans, and milk. The lamb advertising intensity has declined in recent years primarily 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.

PREVIOUS RESEARCH

Published analyses of the U.S. demand for lamb are limited and none has tested the statistical significance of advertising and promotion as a lamb demand driver. Recent studies include RTI International (2007), Shiflett et al. (2006), Schroeder et al. (2001), Paarlberg and Lee (2001), and Byrne et al. (1993). Much of this research was based on earlier work primarily by Purcell (1989) and also by Whipple and Menkhaus (1989). The seminal study on consumer demand for food commodities by George and King (1971) includes a treatment of lamb demand. Finally, an early

Figure 3: Lamb Advertising Intensity (Advertising to Sales Ratio), 1978/79-2007/08



study of lamb imports by Carman and Maetzold (1971) which benefits from early results of George and King develops a model of lamb demand.

The principal focus of these past investigations has been on economic and other factors affecting lamb demand. The respective demand functions are modeled using regression analysis and historical data to examine potential drivers of demand with an emphasis on measuring price and income elasticities. The factors most often found to be statistically significant in explaining changes in per capita lamb demand over the years include the real retail price of lamb, the real

retail price of beef, and seasonality. Most studies have concluded that income has not been a statistically significant driver of changes in lamb demand.

The estimated own-price elasticities of per capita lamb demand across most recent studies are similar, ranging from -0.4 to -0.7 except for Schroeder et al. (2001) who report a relatively high price elasticity of -1.1 (Table 1). Analyzing data from earlier time periods, Whipple and Menkhaus (1989) along with George and King (1971) and Carman and Maetzold (1971) find much higher own-price elasticities in the range of -2.0 to -3.0. The range of statistically significant estimated beef-cross price elasticities among recent studies is even more narrow (0.5 to 0.6). Neither pork nor poultry has been consistently shown to be statistically significant substitutes for lamb.

The results on the income elasticity of lamb demand are mixed. RTI International (2007) and Byrne, Capps, and Williams (1993) find that income is not a significant driver of lamb consumption. Shiflett et al. (2006) initially find that income is statistically insignificant in explaining changes in per capita lamb demand. They subsequently add a trend variable to their model and then find a positive and statistically significant relationship between per capita lamb demand and income. This result may be spurious due to collinearity of the income and trend variables used in their analysis as indicted by high reported variance inflation factors of 39.0 and 67.9, respectively. In contrast, Schroeder et al. (2001) report a statistically significant negative relationship between lamb demand and income. The lack of broad evidence of a positive and statistically significant relationship between income and lamb demand may be the result of either the relatively low level of lamb consumption or the fact that most lamb is purchased for special occasions which traditionally feature lamb.

Table 1. Estimated Elasticities of U.S. Per Capita Lamb Demand [a]

Study	Periodicity	Years	Own-price	Import Price	Cross-Price: Beef	Cross-Price: Pork	Cross-Price: Chicken	Income	Advertising
RTI International (2007)	annual	1970-2003	-0.523**	0.293**	–0.041	0.201	0.35**	-0.567	--
Shiflett et al. (2006)	quarterly	1980-2005	-0.665*	--	0.486*	0.179*	ns	0.684*	--
Schroeder et al. (2001)	annual	1978-1999	-1.09*	--	0.57**	0.17	ns	-0.54**	--
Paarlberg and Lee (2001)	quarterly	1989-1998	-0.437*	--	--	--	--	--	--
Byrne et al. (1993)	annual	1978-1990	-0.62*	--	ns	0.131**	--	0.303	--
Purcell (1989)	annual	1970-1987	-0.511*	--	--	--	--	b	--
Whipple and Menkaus (1989)[c]	annual	1950-1987	-3.18*	--	--	--	--	--	--
George and King (1971) [d]	quarterly, annual	1946-1968	-2.6255	--	0.5895	0.8914	0.2336	0.571	--
Carman and Maetzold (1971)[e]	quarterly	1949-1967	Q1: -2.08*	--	Q1: 0.93*	Q1: 0.04	Q1: 0.14	0.571	--
			Q2: -2.06*	--	Q2: 0.63*	Q2: 0.74*	Q2: 0.35*	0.571	--
			Q3: -1.27*	--	Q3: 0.16	Q3: -0.28	Q3: 0.41*	0.571	--
			Q4: -1.99*	--	Q4: 1.52*	Q4: -0.03	Q4: 0.05	0.571	--

[a] Dependent variable in all cases is per capita lamb consumption except for RTI study which uses per capita consumption of only domestic lamb (excluding imported lamb). * = significant at the 1% level, ** = significant at the 5% level, ns = not statistically significant, and -- = not considered in the analysis.
[b] Estimated coefficient positive but not statistically significant. Elasticity not reported.
[c] Demand equation estimated as price dependent so own-price elasticity is the inverse of the estimated price flexibility and other price elasticities and income elasticity of lamb demand are not estimated.
[d] Alternative equations using quarterly and annual data were estimated. The choice of coefficients was "based on the properties of the estimates" (p.115). Statistical significance not reported.
[e] Coefficients estimated subject to constraint of the income coefficient taken from George and King (1971).

Byrne, Capps, and Williams (1993) and Shiflett et al. (2007) both use quarterly data in their analyses and find that seasonality is an additional statistically significant determinant of per capita lamb demand. Both studies report that lamb consumption typically is highest in the first and fourth quarters of the year. Using monthly data, Williams et al. (2008) econometrically analyze the relationship between religious holy days (Orthodox Easter and Muslim holy days of Ramadan and Eidu al-fitr) and lamb slaughter[2]. They find that these religious holy days during certain periods of the year significantly affect monthly and annual lamb disappearance and that their effect is increasing over time. These findings along with the results on the seasonality of lamb demand provide some evidence for the hypothesis that lamb purchases are more a function of religious and ethnic considerations than income.

Among all previous lamb demand studies, only Carman and Maetzold (1971) explicitly recognize the potential omitted variable bias from excluding lamb promotion and advertising as an explanatory variable. Although not previously analyzed for lamb, the responsiveness of the demand for other commodities to their respective checkoff-funded advertising and promotion programs has been the subject of numerous studies. Kinnucan and Zheng (2005) provide an overview of some recent estimates of the checkoff advertising and promotion elasticities for dairy, beef, pork, and cotton. Williams and Nichols (1998) provide a historical summary of the advertising and promotion elasticities estimated across a broader range of commodities. Rusmevichientong and Kaiser (2009) compare the advertising and promotion responses of various checkoff-funded export promotion programs. Alston et al. (2006) review past evaluations of California mandated commodity promotion programs, covering a broad range of commodities,

[2] The econometric model and analysis were authored by Douglas D. Heady and included as an appendix to the Williams et al. (2008) study.

including almonds, avocados, dried plums (prunes), eggs, raisins, strawberries, table grapes, walnuts, and milk and dairy products.

While the estimates of the advertising and promotion elasticities have ranged widely even for the same commodity in different studies, the consensus across a broad range of research is that advertising and promotion can, but does not always, effectively increase commodity sales. Another consistent finding is that the response of sales to advertising (the advertising elasticity) for most commodities is small and usually in the range between close to zero and 0.10. For U.S. fluid milk sales, for example, the reported estimated generic advertising elasticities have ranged from as low as 0.0018 (Kinnucan et al., 2001) to as high as 0.150 (Schmit et al., 2002). For red meat, the estimated advertising elasticities are equally small, ranging from a low of -0.00004 (Boetel and Liu, 2003) to 0.028 (Ward, 2001) for beef and from -0.0005 (Brester and Schroeder, 1995) to 0.11 (Davis et al., 2001) for pork.

For cotton and orange juice, the results are similar. Estimated cotton checkoff advertising and promotion elasticities range from 0.023 (Murray, et al., 2001) to 0.066 (Ding and Kinnucan, 1996). A more recent and detailed study of the cotton checkoff program estimates the retail-level advertising elasticity for cotton to be 0.05 (Capps and Williams, 2006). Williams, Capps, and Bessler (2004) estimated the orange juice checkoff program advertising and promotion elasticity at 0.127. In contrast, Ward (1988) found an orange juice advertising elasticity of 0.027 while Lee and Brown (1992) found an advertising elasticity of 0.01. For soybeans, Williams and Capps (2009) estimate the soybean checkoff promotion elasticities of domestic soybean, soymeal, and soyoil demands to be 0.046, 0.034, and 0.029, respectively. For foreign market demands for soybeans, soymeal, and soyoil, they estimate the promotion elasticities to range from 0.029 to

0.63, 0.034 to 0.062, and 0.020 to 0.052, respectively, depending on the country or region of promotion.

Using a benefit-cost analysis approach, most studies conclude that checkoff programs increase sales revenues (net of the cost of promotions) or producer's surplus by more than the cost of the advertising and promotion programs resulting in estimated benefit-cost ratios (BCRs) much in excess of 1. Ward (2006) suggests a "reasonably robust" rule of thumb of 4:1 to 6:1 for the range of commodity checkoff BCRs despite differences across studies in how "benefits" are defined and measured. While there are many exceptions, the range of estimated commodity checkoff BCRs is more in the neighborhood of 2:1 to 10:1 across studies of the same and different checkoff commodities. For fluid milk, for example, the estimated BCRs range from as low as 1.85:1 (Ward and MacDonald, 1986) to at least 7.04:1 (Liu et al., 1989). More recently Kaiser (2000) estimated the fluid milk return to advertising to be 4.3:1. Other studies focusing on such diverse checkoff commodities as beef (e.g., Ward, 2001), orange juice (e.g, Williams, Capps, and Bessler, 2004), cotton (e.g, Capps and Williams, 2006), eggs (e.g., Schmit, Reberte, and Kaiser, 1996; Reberte, Schmit, and Kaiser, 1996), rice (e.g., Rusmevichientong and Kaiser, 2009); flowers (Ward, 2004), prunes (Alston et al., 1998), soybeans (e.g., Williams and Capps, 2009) and others have reported similar BCRs from their respective advertising and promotion programs.

Some checkoff commodities, like lamb, compete with imports so that generic advertising and promotion which successfully shifts out their domestic demand curves may well encourage greater imports and divert some of any gains from advertising to foreign producers. Although well known, this type of potential free-rider effect of advertising and promotion is accounted for in surprisingly few analyses of checkoff programs that face such a possibility. The free rider

problem of imports probably has been most consistently considered in the case of orange juice advertising (e.g, Lee and Fairchild, 1988; Brown, Lee, and Spreen, 1996; Williams, Capps, and Bessler, 2004) although various other researchers have accounted for the import effect for commodities like salmon (Kinnucan and Myrland, 2003), cotton (e.g., Capps and Williams, 2006), pork (Davis, et al., 2001), and a few others.

METHODOLOGY AND DATA

To address the first of the key questions that are the focus of this analysis (i.e., the effect of lamb advertising and promotion on U.S. lamb demand), we estimate the parameters of a single equation for U.S. lamb demand using ordinary least squares as is common with many studies of checkoff promotion programs, a point also noted by Rusmevichientong and Kaiser (2009). The general form of the lamb demand equation is expressed as:

(1) $C_t/POP_t = f(P_t/I_t, P_{it}/I_t, Y_t/POP_t/I_t, E_t/I_t,)$

where C = 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; E = lamb promotion expenditures, and t = the current year.

For estimation, we adopt a linear functional form of equation (1), as is also common among analyses of checkoff programs (Kinnucan and Zheng, 2005). The use of a constant elasticity (double log) formulation often used in generic promotion studies was not possible due to the presence of zero values for lamb promotion expenditures in some years between the end of the Wool Incentive Program and the establishment of the national lamb checkoff program. For the same reason, a logarithmic transformation of the expenditure data to allow for diminishing marginal returns to lamb promotion expenditures cannot be done. Consequently, we use a square

root transformation of E_t/I_t in equation (1) for that purpose which is also a common practice (Kinnucan and Zheng, 2005).

To allow for the possibility of carryover effects of lamb advertising and promotion, we test for lag formulation and lag length using three commonly used, alternative lag models: (1) the polynomial distributed lag formulation, (2) moving averages, and (3) simple lags of varying lengths. 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 one year with endpoint constraints was selected.

The analysis utilizes annual historical data for marketing years 1978/79 through 2008/09 (July/June). Data for per capita lamb consumption (C/POP) are available from USDA (USDAb, 2009) while retail prices (P and P_i) are from the Livestock Marketing Information Center (LMIC, 2009) and the Bureau of Labor Statistics (USDL, 2009). Data for personal disposable income (Y), population (POP), and inflation (I) are provided by the Federal Reserve Bank (FRB, 2009). Data for lamb advertising and promotion expenditures since July 2002 when the national lamb checkoff program began operations were provided by ALB (ALBa, 2002-June 2009). Lamb promotion expenditures over 1978/79 through 2001/02 were provided by ASIA.

To address the second key question (the returns from lamb advertising and promotion), we use the results of the lamb demand estimation to calculate the benefit-cost ratio (BCR) to lamb advertising and promotion. The first step is to use the estimated promotion elasticity to

calculate the change in U.S. lamb consumption (C) effected by lamb advertising and in any given year as:

$$(2) \qquad C_t^A - C_t^Z = [e\, PER_t^A]POP_t$$

where t refers to the current year, C^A = actual lamb consumption; C^Z = level of lamb consumption that would have occurred with no promotion expenditures; PER^A = actual per capita consumption; POP = population; and e = estimated promotion elasticity.

Then, using the results of equation (1), the Lamb Sales BCR (the additional lamb sold per dollar of promotion) is calculated as:

$$(3) \qquad \text{Lamb Sales BCR} = \frac{\sum_{t=1}^{T}(C_t^A - C_t^Z)}{\sum_{t=1}^{T} E_t}$$

where E_t = annual expenditures on lamb advertising and promotion. The Revenue BCR (the additional revenues generated per dollar spent on promotion) is then calculated as:

$$(4) \qquad \text{Revenue BCR} = \frac{\sum_{t=1}^{T} P_t^A (C_t^A - C_t^Z)}{\sum_{t=1}^{T} E_t}$$

where P^A = the actual retail price of lamb[3].

Note that equation (4) calculates the benefits from advertising and promotion at the retail level. The important question, as emphasized by Wohlgenant (2006), is how much of the increased retail-level revenues generated actually reaches lamb producers. To attempt an

[3] As specified and estimated, the lamb demand model implicitly assumes that lamb price is unaffected by promotion. Indeed, a single equation demand model for any commodity assumes that the own price is unaffected by changes in any of the exogenous variables. In this case, at least, the assumption is justified because even though the effects of promotion on lamb demand are statistically significant, they are quite small in absolute terms. Thus, little effect on lamb price would be expected from changes in promotion. Further, given the likely small absolute effect of promotion on lamb price, the cost of building the extensive sheep and lamb industry model that would be required to allow for a response of lamb price to promotion would certainly exceed the benefits for the purposes of this analysis.

estimate of the portion of the retail level returns to lamb advertising and promotion that accrues to lamb producers, we follow the common practice of applying the USDA estimates of the shares of the retail dollar earned by producers to the results of equation (4).

Finally, to address the third key question (effect of lamb advertising and promotion on the imports), we estimate an equation for the import share of consumption. As far as we are aware, no previous study has econometrically examined the behavior of imports relative to total U.S. lamb consumption. Only four studies, two of which are unpublished doctoral dissertations, have estimated lamb import equations, none of which considered lamb advertising and promotion as a potential determinant. Whipple and Menkhaus (1989) estimate a U.S. lamb import equation using data for 1950-1985 and conclude that imports are driven by the U.S. and import prices of lamb and Australian and New Zealand lamb production. In the Deese (2003) lamb import demand model, the primary driver is U.S. income. The only other statistically significant variable in his model is the U.S. price of lamb. Ribera (2004) concludes that the primary determinants of U.S. lamb imports are Australian lamb production, the U.S.-Australian exchange rate, and the tariff imposed on lamb imports in response to the 201 trade complaint ruling of the ITC lodged by the U.S. lamb industry (as represented by a binary variable). Muhammad, Jones, and Hahn (2004) use a two-stage differential production approach to estimate the derived demand and output supply for U.S. lamb imports, estimate demand elasticities, and determine the impact of TRQ reductions on imports. They find that while lamb imports are positively impacted by the U.S. price of lamb, the TRQ actually led to higher levels of imports which they partially explain as the result of exchange rate movements during that period which increased the purchasing power of U.S. dollars.

The import share of the domestic consumption of any commodity is often modeled as a function of real prices, exchange rates, and other variables as determined by the particular markets and commodities being analyzed (see Durham and Lee, 2009; Jones, 2006; Chang and Hsia, 2000; and Lee, Henneberry, and Pyles, 1991 for examples of meat import share models). Accordingly, we specify the import share of U.S. lamb consumption as:

(5) $M_t = f(P_t/I_t, PM_t/I_t, RX_t, E_t/I_t, TRQ)$

where M = the import share of U.S. lamb consumption (i.e., the sum of imports from Australia and New Zealand divided by U.S. lamb consumption; PM = the trade weighted price of lamb imported from Australia and New Zealand; RX = the real lamb-trade-weighted exchange rate of the Australian and New Zealand currencies to the U.S. dollar; TRQ = indicator variable for the removal of the U.S. tariff rate quota on imported lamb in 2001/02; and P, I, and E are as defined in equation (1). Because we strongly suspect a cross-temporal process and sluggishness in the adjustment of the dependent variable in equation (5), as is often the case with international trade data, we include the lagged dependent variable as an additional regressor in the estimated version of the model as suggested by Keele and Kelly (2006)[4].

The innovation in this lamb import share specification is the addition of lamb advertising and promotion expenditures as a potential explanatory variable. As with the lamb demand equation and for the same reasons, a square root rather than a logarithmic transformation of E_t/I_t is used. Following the same procedure to test for lag formulation and lag length as used for the

[4] Baker (2007) argues that in the case of autocorrelation caused by an omitted variable, the lagged dependent variable is "a good proxy for the omitted variable, even if the omitted variable is unknown and/or unmeasurable – and therefore mitigates the specification bias. Concerns that addressing autocorrelation by adding a LDV [lagged dependent variable] results in attenuated coefficients(s) on the variable(s) of interest, then, have the problem reversed: the LDV estimate is less biased than the OLS estimate."

lamb demand equation, a simple, one-year lag is selected for the square root transformed expenditure variable in the lamb import share equation.

Theoretically, advertising and promotion could have a positive effect, a negative effect, or no effect on the lamb import share. If advertising and promotion has a greater effect on lamb imports than on total U.S. demand, the consequence would be an increasing import share. However, if the effect on lamb imports is smaller than on total demand, the advertising and promotion effect on the lamb import share would be negative. Finally, if advertising and promotion increase imports and total demand proportionately or have no effect on either, then advertising and promotion would not have any measureable effect on the lamb import share.

To estimate the parameters of equation (5), annual data for 1989/90 through 2006/07 were used. The lamb import share was calculated as imports from Australia and New Zealand divided by total U.S. lamb disappearance (carcass weight) using FATUS import data (USDAe, 2009) and USDA lamb disappearance data (USDAb, 2009). The unit values of imported lamb for both Australia and New Zealand were obtained from the U.S. Department of Commerce (USDOC, 2008) and used as proxies for import price from each country. A weighted average price of lamb imports was calculated by multiplying each country's lamb price by its share of total lamb meat exported to the U.S. The trade-weighted exchange rate was calculated by multiplying each country's real exchange rate by its share of U.S. lamb imports. The real exchange rates were calculated by multiplying the nominal exchange rates obtained from USDA (USDAa, 2009) by the ratio of the U.S. to foreign currency consumer price indices obtained from the Bureau of Labor Statistics (USDL, 2009). All other data were obtained from the same sources as for the lamb demand estimation.

STATISTICAL RESULTS

The estimated model explains about 83% of the variability in per capita lamb consumption over the 1978/79-2008/09 period of analysis (Table 2). The OLS parameter estimates indicate that advertising and promotion has had a statistically significant effect on per capita lamb consumption over the years[5]. The prices of lamb and the prices of beef and pork are also statistically significant. However, neither income nor the price of chicken are statistically significant, consistent with most previous studies on lamb demand.

The estimated own-price elasticity of lamb of -0.75 slightly above the range of previous estimates (see Table 1). The estimated beef cross-price elasticity of 0.63 is also slightly above those estimated by Schroeder et al. (2001) and Shiflett (2006). The estimated pork cross price elasticity of 0.41 is also higher than previous estimates. The implication is that both beef and pork are substitute meat products for lamb. The income elasticity is estimated at 0.29 but is not statistically different from zero providing additional evidence that lamb consumption is independent of changes in real income.

The lamb promotion expenditure elasticity is estimated over the entire period of 1978/79-2008/09 to be 0.040, consistent with those estimated for other checkoff commodities. Using the same model with data for only the 1978/79-2001/02 period prior to the existence of the American Lamb Board, the advertising and promotion elasticity was estimated to be 0.043. The implication is that the marginal effects of lamb advertising and promotion have decreased with the implementation of the national lamb checkoff program, perhaps as a result of the large decline

[5] A Hausman specification test using the Hausman option in the FIT statement in the MODEL procedure (PROC MODEL) of SAS 9.1.3 concluded that for estimating the parameters of the lamb demand model, OLS is preferred over 2SLS. Thus, instrumental-variable estimation to purge the lamb price in the lamb demand equation of correlation with the error term was deemed unnecessary.

Table 2: The Lamb Demand Model[a]

$LN(C_t/POP_t) = -3.747 - 0.750*LN(P_{lt}/I_t) + 0.626*LN(P_{bt}/I_t) + 0.405*LN(P_{pt}/I_t) + 0.266*LN(Y_t/I_t) +$
(3.777) (0.172) (0.240) (0.196) (0.287)

$0.00090*(E_t/I_t)^{1/2} + 0.00090*(E_t/I_{t-1})^{1/2}$
(0.00048) (0.00048)
[0.040][b]

$R^2 = 0.862$ R^2 (adjusted) = 0.833 DW = 1.589

where
C = per capita lamb consumption (pounds)
P_l = retail price of lamb ($/lb)
P_b = retail price of beef ($/lb)
P_p = retail price of pork ($/lb)
Y = per capita disposable income ($)
I = consumer price index (1999=100)
E = lamb advertising and promotion expenditures ($ thousands)

[a] Numbers in parentheses are standard errors. Numbers in brackets are elasticities.
[b] Elasticity of per capita lamb consumption with respect to real expenditures (E_t/I_t).

in total funds available to ALB for advertising and promotion compared to what had been formerly available to ASIA.

Turning to the estimation of the lamb import share equation, the estimated model explains over 99% of the variation of the lamb import share over the 1979/90-2006/07 period (Table 3). All estimated coefficients have the expected signs except for the weighted price of imported lamb which is not statistically significant. The Durbin-h test indicates no evidence of residual autocorrelation.

At the sample means, the U.S. lamb cross-price elasticity of the import share (M) is 2.64 and 4.67 over the long-run, implying an elastic response of the import share to changes in the U.S. price of lamb over time (Table 3). The insignificance of the import price of lamb could be due to a number of factors, including the possibility that U.S. consumers react more to changes in the U.S. price that in the import price when deciding whether to buy U.S. or imported lamb. Also likely is that the import unit value does not represent the prices of imported lamb well.

Table 3: The Lamb Import Share Model[a]

$$M_t = -0.5346 + 0.1207 * P_{lt}/I_t + 0.0162 * PM_t/I_t + 0.0573 * RX_t - 0.0010 * (E_{t-1}/I_{t-1})^{1/2} + 0.4343 * M_{t-1} + 0.0498 * TRQ$$

(0.1586)	(0.0354)	(0.0175)	(0.0252)	(0.0003)	(0.1544)	(0.0192)
	[2.64]		[0.101]	[-0.0896][b]		

$R^2 = 0.992$ R^2 (adjusted) = 0.990 Durbin-h = -1.024

where M = the import share of U.S. lamb consumption (ratio)
P_l = retail price of lamb ($/lb)
PM = trade weighted price of lamb imported from Australia and New Zealand ($/lb)
RX = real lamb-trade-weighted exchange rate (Australian and New Zealand currencies to $U.S.)
I = consumer price index (1999=100)
E = lamb advertising and promotion expenditures ($ thousands)
TRQ = indicator variable for the removal of the U.S. tariff rate quota on imported lamb in 2001/02

[a] Numbers in parentheses are standard errors. Numbers in brackets are elasticities.
[b] Elasticity of the import share with respect to real expenditures (E_t/I_t).

Unfortunately, no price series for imported lamb is available (Williams et al., 2008). As expected, both the trade weighted exchange rate and removal of the TRQ have had statistically significant, positive effects on the share of U.S. lamb consumption coming from imports.

Lamb promotion expenditures, however, have had a statistically significant, negative effect on the lamb import share (Table 3). Thus, increases in lamb promotion expenditures have had a tendency to switch U.S. consumers from imported to U.S.-produced lamb consistent with the objectives of the current Lamb Checkoff Program.

BENEFIT-COST ANALYSIS

The statistical results imply that the Lamb Checkoff Program has had a tendency to increase the total volume of lamb consumed over the years by increasing the volume consumed of domestically produced lamb by more than that of imported lamb. The more critical concern, perhaps, is the gains to producers from any consumption increase achieved through promotion relative to the cost of the promotion. Equation (3) provides a measure of the benefits of the promotion programs to producers in terms of the additional lbs of lamb sold per dollar of promotion spent over the years. Using the results of the statistical analysis, the Lamb Sales BCR

for the current Lamb Checkoff Program is 7.90, meaning that from its inception through 2008/09, the ALB advertising and promotion program has generated roughly 7.90 additional pounds of total lamb consumption for every dollar spent on advertising and promotion. According to equation (4), that translates into additional lamb sales revenue of $44.14 for every dollar spent on promotion.

Over the pre-ALB period of 1978/79-2001/02, advertising and promotion efforts translated into 5.70 additional pounds of total lamb consumption per dollar spent on promotion and $26.93 in additional lamb sales per dollar spent. Consequently, the programmatic activities of the ALB have been relatively more successful in stimulating lamb than past promotional efforts on a per dollar spent basis.

Note that the benefits are calculated at the retail level. An important question is how much of the increased retail-level revenues generated actually reaches lamb producers. For many checkoff programs, the portion of the revenues generated that accrue to producers is calculated using USDA estimates of the share of the retail dollar that is earned by farmers. Unfortunately, however, the USDA does not calculate that share for lamb. For beef, USDA calculates the farmers' share of the retail dollar spent on beef was about 46.2% on average between 2003 and 2009 (USDAc, 2009). For pork, the estimated share was lower at 28.7% over the same period. If lamb producers earned the same share of the retail dollar as beef producers, then the average revenue BCR from the lamb promotion program at the producer level over 2002/03-2008/09 would have been $20.39 per dollar spent on promotion. If lamb producers earned the same share of the retail dollar as pork producers, then the lamb revenue BCR at the producer level would be $12.68 per dollar of promotion. Even if the share earned by lamb producers was much lower, even at 10% for example, lamb producers would still be earning

$4.41 for every dollar invested in the Lamb Checkoff Program, a reasonable return on investment.

These estimated BCRs reflect a relatively high return to the small investment made by the lamb industry in promoting lamb demand. They also imply that the lamb promotion program continues to be heavily under-funded, a conclusion that is consistent with the experience of other commodity checkoff organizations. In other words, while an increase in the assessment would result in more funds for promoting lamb, the greater the increase, the lower the calculated BCR would likely be given the diminishing effectiveness of each additional dollar of promotion that is normally experienced by commodity checkoff organizations. However, with such a sizeable BCR, the lamb checkoff assessment could be increased substantially and still realize a healthy return. In fact, however, nominal ALB advertising and promotion expenditures dropped steadily from $2.68 million in 2003/04 to a low of $1.30 million in 2006/07. Promotion expenditures jumped to $1.65 million in 2007/08 but slumped again to $1.38 million in 2008/09. The calculated BCR for lamb suggests a notable opportunity cost in terms of lost revenue to the lamb industry over the last few years from every dollar of reduced checkoff revenues.

CONCLUSIONS

The main conclusion from this analysis is that lamb promotion has tended to enhance the demand for lamb over the years, generating an impressive return to producers ($44.14 per dollar spent on promotion). At the same time, lamb promotion has tended to switch U.S. consumers from imported to U.S.-produced lamb consistent with the objectives of the current Lamb Checkoff Program. Given the low investment intensity ratio, however, the actual impact of the current Lamb Checkoff Program on the volume of lamb sold is rather small at about 7.9 lbs per

dollar spent on promotion, an increase of less than 4% per year. Past promotion efforts over the 1978/79-2001/02 period were also effective in enhancing lamb demand but at a somewhat lower rate of return to producers. Given the relatively high BCR estimated for lamb promotion, the reduction in promotion expenditures over the last several years translates into a notable opportunity cost to the lamb industry in terms of lost industry revenues. An increase in the assessment rate would generate a large return for every additional dollar of assessment paid by the industry. In other words, for every dollar in additional assessment NOT paid and spent on lamb promotion, the industry loses up to $44.14 in revenue. Research shows that increases in checkoff assessment rates and total spending on promotion are usually accompanied by a reduction in the BCR so that an increase in the lamb checkoff assessment would be expected to result in a lower return to promotion. But with such a high estimated BCR, the industry could increase the assessment rate substantially and still expect to generate a reasonable rate of return comparable to what is earned by the beef, pork, cotton, soybeans, and other similar checkoff programs.

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