

**ANALYZING THE EFFECTIVENESS OF THE LAMB  
PROMOTION, RESEARCH, AND INFORMATION ORDER**

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Agribusiness, Food, and Consumer Economics Research Center (AFCERC) Commodity Market Research Report No. CM-02-11, January 2011 by Dr. Gary W. Williams and Dr. Oral Capps, Jr.

**ABSTRACT**

We provide an updated analysis of the effectiveness of the Lamb Checkoff program conducted by The American Lamb Board since July 2002. The principal conclusion is that the program has resulted in roughly 7.1 to 7.5 pounds of lamb consumption per dollar spent on promotion activities which translates into \$37.16 to \$39.34 in additional lamb sales per dollar spent on promotion activities. This update is addressed through an econometric analysis of the retail demand for lamb in the United States 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 at the retail level. We also provide estimates of the benefit-cost ratio at the producer level conditional on recent farm shares of the retail dollar associated with beef and pork.

**ACKNOWLEDGEMENTS**

The research reported here was conducted under contract with the American Lamb Board. The lamb advertising and promotion data used in this study were collected with the assistance of the American Sheep Industry Association, Inc. (ASIA) and the American Lamb Board (ALB). The conclusions reached and any views expressed, however, are those of the authors and may not represent those of ASIA, ALB, or Texas A&M University.

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## ANALYZING THE EFFECTIVENESS OF THE LAMB PROMOTION, RESEARCH, AND INFORMATION ORDER

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### EXECUTIVE SUMMARY

We present an updated analysis of the effectiveness of the Lamb Promotion, Research, and Information Order, better known as the American Lamb Checkoff Program, in shifting out the demand for lamb. The Lamb Checkoff Program is designed to expand market share of American Lamb by: (1) getting people to ask for American Lamb year-round; (2) branding American Lamb as the preferred choice in the marketplace; (3) differentiating American Lamb from competitors with the “10,000 Miles Fresher” and the “American Lamb from American Land” advertising campaigns; (4) minimizing the volatility of seasonal product sales through targeted promotions; (5) promoting to encourage use of the whole lamb – using all cuts; and (6) leveraging and expanding ALB resources via cooperative relationships with marketing partners.

The overall objective of this analysis is to determine through nonpartisan econometric analysis the impact of the advertising and promotion dollars spent by the ALB on lamb consumption at the retail level of the marketing channel. Economic factors affecting lamb consumption considered are as follows: (1) the retail price of lamb; (2) the retail prices of beef, pork, and chicken; (3) personal disposable income; (4) population; (5) inflation; and (6) advertising and promotion expenditures for lamb. The objective of the regression analysis is to control for the effects of all economic factors other than the Lamb Checkoff Program and, thus, isolate the specific impacts of advertising and promotion on lamb. The results allow a measurement of the change in lamb consumption (and lamb sales at fixed process) attributable to advertising and promotion dollar expenditures, holding all other factors constant.

The main conclusions from this analysis are the following:

- Doubling ALB lamb promotion expenditures in any given year would boost national lamb consumption by roughly 4 percent.
- The ALB lamb promotion program has resulted in roughly 7.1 to 7.5 additional pounds of total lamb consumption per dollar spent on advertising and promotion and \$37.16 to \$39.34 in additional lamb sales per dollar spent on advertising and promotion. These figures are lower than those from previous work conducted by Williams, Capps, and Dang (2010). The lower returns to ALB lamb promotion expenditures in the updated analysis is consistent with both theory and the experience of other commodity checkoff organizations that the relatively high marginal returns to ALB promotion will tend to diminish somewhat over time as the program matures.
- Past promotion efforts over the 1978/79-2001/02 period were effective in enhancing lamb demand but less so than the recent activities of the ALB. Over the 1978/79-2001/02 period before the establishment of the American Lamb Board and the lamb checkoff

program, advertising and promotion efforts translated into a 5.0 to 5.4 additional pounds of total lamb consumption per dollar spent and \$24.30 to \$25.72 in additional lamb sales.

The updated analysis thus confirms that ALB program expenditures since 2002/03 have successfully increased the demand for domestic lamb, after accounting for other economic forces. Nevertheless, changes in retail lamb consumption due to promotional efforts must continue to be monitored. For future work, we recommend the use of a quarterly demand model for lamb as opposed to the annual models currently in use. The quarterly demand model will allow the analysis to focus specifically on the ALB advertising and promotion expenditures made since July 2002 without concern for earlier advertising and promotion efforts.

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## **ANALYZING THE EFFECTIVENESS OF THE LAMB PROMOTION, RESEARCH, AND INFORMATION ORDER**

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### **INTRODUCTION**

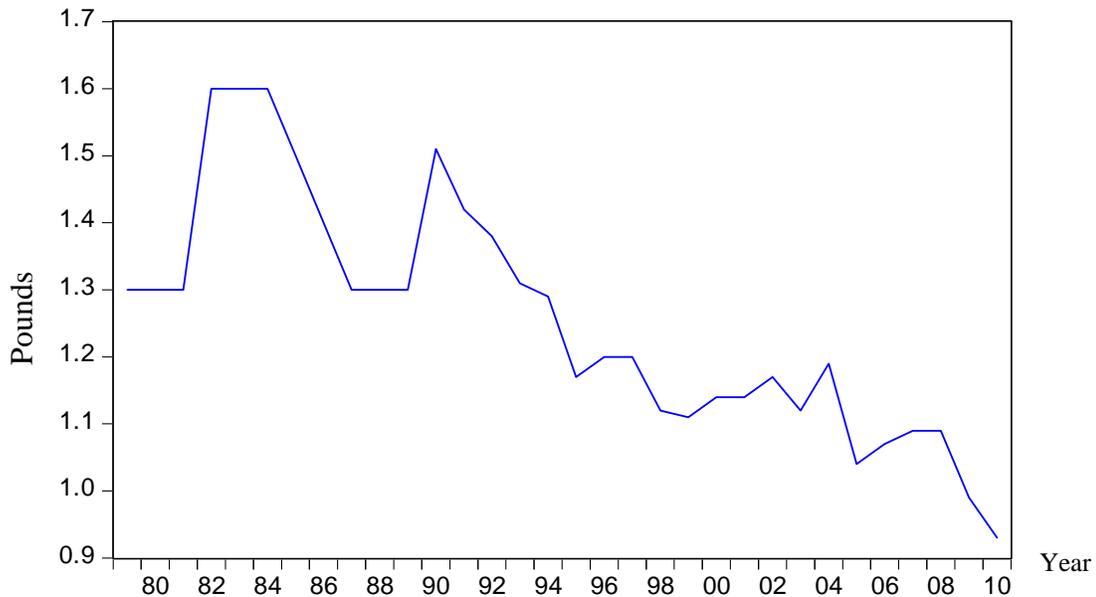
On a retail equivalent basis, per capita lamb consumption ranged from 1.3 pounds to 1.6 pounds from 1979 to 1990. Since 1990, however, per capita lamb consumption for the most part has been on the decline. As exhibited in Figure 1, the current per capita lamb consumption is about 0.93 pounds. In fact, over the last two years, consumption was below one pound per capita.

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 American 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.

We provide an updated analysis of the effectiveness of the American Lamb Checkoff Program, in shifting out the demand for lamb. The collection of assessments currently provides an annual operating budget of approximately \$1.4 million. The cumulative collection of assessments from 2002/03 to 2009/10 amounts to \$11.7 million or roughly \$366,000 per quarter (ALBa). The 13-member ALB that administers the Checkoff program includes six producers, three packers or first handlers, three feeders and one seedstock producer, all appointed by the U.S. Secretary of Agriculture. The Board meets at least three times per year to establish goals and budgets for new programs and to evaluate the success of work completed. Board policies are implemented by a three-member staff in Denver, Colorado. Administrative costs are limited to a maximum of 10% of collections in any fiscal year so that most of the funds are used for promotional purposes. USDA has oversight responsibilities for the administration of the program. All activities funded with Checkoff dollars must comply with the Act and the Order and must be approved by the U. S. Department of Agriculture (USDA).

**Figure 1. Annual Per Capita Lamb Consumption from 1978/79 to 2009/10**



Source: Livestock Marketing Information Center

The Lamb Checkoff Program is designed to expand market share of American Lamb by: (1) getting people to ask for American Lamb year-round; (2) branding American Lamb as the preferred choice in the marketplace; (3) differentiating American Lamb from competitors with the “10,000 Miles Fresher” and the “American Lamb from American Land” advertising campaigns; (4) minimizing the volatility of seasonal product sales through targeted promotions; (5) promoting to encourage use of the whole lamb – using all cuts; and (6) leveraging and expanding ALB resources via cooperative relationships with marketing partners.

The overall objective of this analysis is to determine through nonpartisan econometric analysis the impact of the advertising and promotion dollars spent by the ALB on lamb consumption at the retail level of the marketing channel as well as at the producer level. The objective of this specific report is to update previous analyses conducted from 2004 to 2009 using more recent data to determine the current status of the effectiveness of the ALB advertising and promotion efforts. With the econometric analysis, we are in position to isolate and to 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 at the retail and at the producer level.

## **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 made the 1995 crops the last to be supported under the act (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 3).

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. 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 2009/10, the ALB has spent a total of about \$11.7 million on lamb advertising and promotion, an average of about \$1.4 million per marketing year (July-June), 38% 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, 2010). 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 (Williams, Capps, and Dang, 2010).

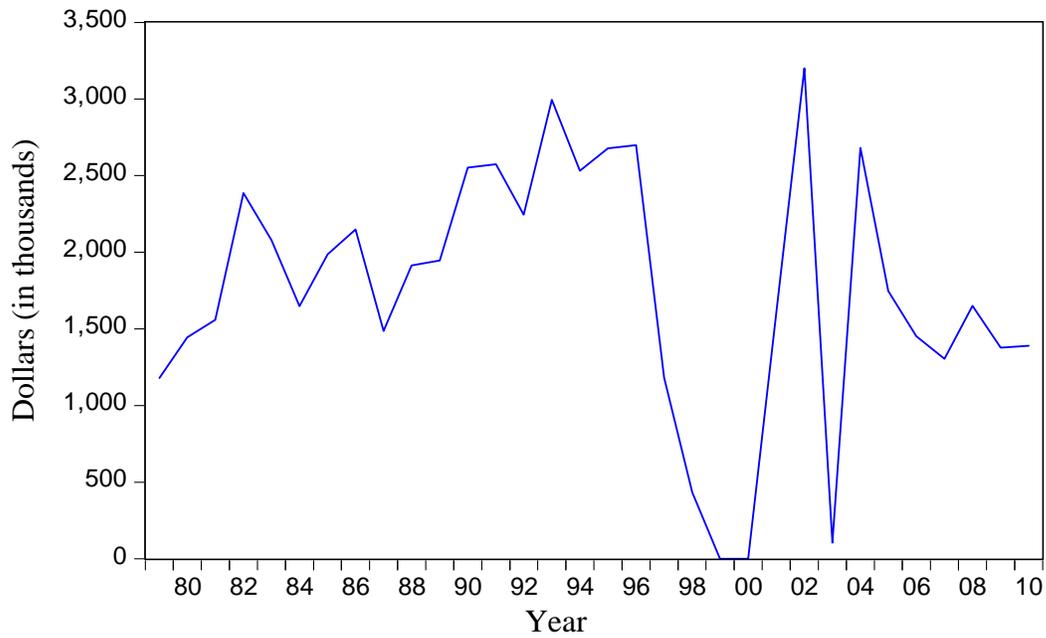
Nominal and real (or inflation-adjusted) advertising and promotion expenditures over the period 1978/79 to 2009/10 are exhibited in Figure 2 and in Figure 3. The sum of the nominal promotion expenditures made by ALB from 2002/03 to 2009/10 amounts to \$11.7 million. ALB expenditures began in 2002/03 and in real terms amounted to roughly \$96,000. These expenditures rose to more than \$2.4 million in 2003/04 before falling to slightly more than \$1.5 million in 2004/05 and to \$1.2 million in 2005/06. Currently, ALB expenditures, adjusted for inflation, are about \$1.1 million. Prior to the establishment of the ALB, annual inflation-adjusted expenditures on lamb promotion by ASIA ranged from \$0 to \$4.2 million.

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 have accounted for an increasing share of ALB promotion expenditures from about 44% in 2004/05 to just under 70% to 80% in later years (Figure 4). 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 education tools such as sales sheets, fabrication videos, “how to” materials, and an electronic foodservice newsletter that is distributed quarterly to chefs and culinary educators.

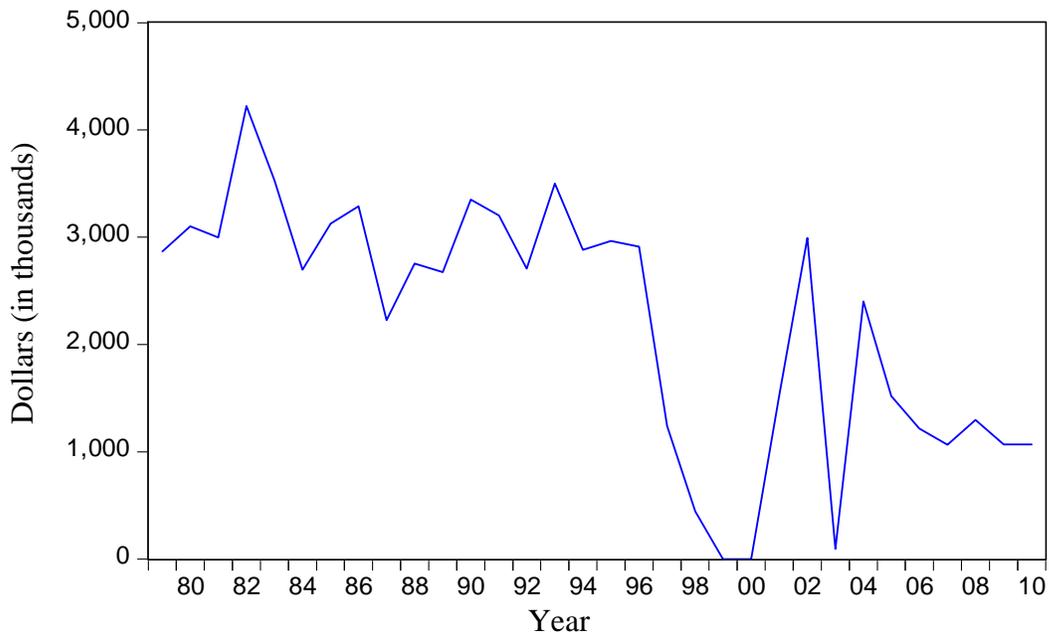
Compared to the value of lamb purchases by consumers each year, the amount of funds that the lamb checkoff program collects for the promotion of lamb is extremely small. The annual lamb advertising-to-sales ratio (often referred to as the investment intensity ratio) over the 1978/79 to 2009/10 period ranged from a minimum of zero in 1999/2000 and 2000/01 to a high of 0.40% in 1989/90, averaging 0.22% between 1978/79 and 1995/96 but only 0.07% since the current Lamb Checkoff Program was established (Figure 5). At no more than about two-fifths 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.

**Figure 2: Annual Nominal Lamb Promotion Expenditures (in thousands of dollars) Over the Period 1978/79 to 2009/10**



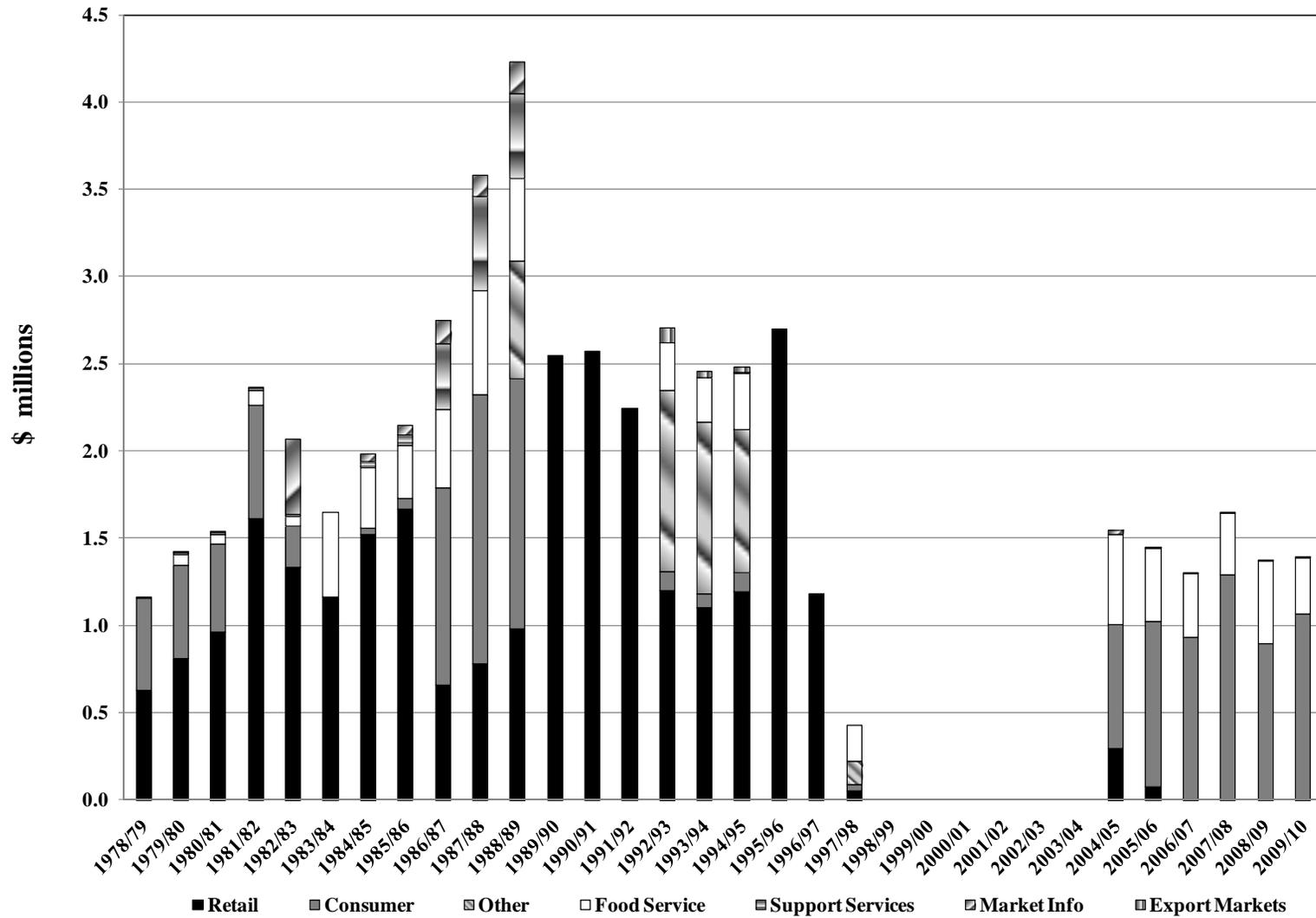
Source: The American Sheep Industry Association and the American Lamb Board

**Figure 3. Real (Inflation-Adjusted) Lamb Promotion Expenditures, 1978/79 to 2009/10**



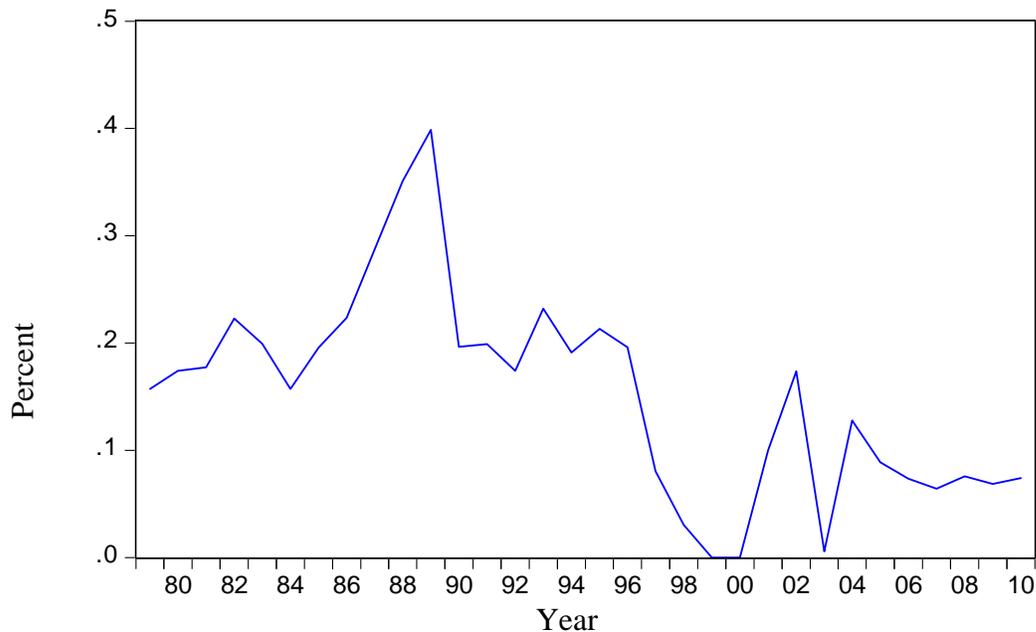
Source: The American Sheep Industry Association and the American Lamb Board

**Figure 4. Lamb Promotion Expenditures by Category, 1978/79 to 2009/10\***



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

**Figure 5. Advertising-to-Sales Ratios from 1978/79 to 2009/10**



Source: Calculations by the authors.

### **PREVIOUS RESEARCH**

Published analyses of the U.S. demand for lamb are limited, and only Williams, Capps, and Dang (2010) have 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, Capps, and Williams (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 study of lamb imports by Carman and Maetzold (1971) which benefitted from early results of George and King developed 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 seemingly implausible high price elasticity of -1.1 (Table 1). Analyzing data from earlier time periods,

**Table 1. Estimated Elasticities of U.S. Per Capita Lamb Demand <sup>a</sup>**

Study	Periodicity	Years	Own-price	Import Price	Cross-Price				
					Beef	Pork	Chicken	Income	Advertising
Williams, Capps, and Dang (2010)	annual	1979-2010	-0.659	0.634	0.343	0.343	0.308	0.386	
RTI International (2007)	annual	1970-2003	-0.523**	0.293**	-0.041	0.201	0.35**	-0.567	--
Shiflett et al. (2007)	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) <sup>c</sup>	annual	1950-1987	-3.18*	--	--	--	--	--	--
George and King (1971) <sup>d</sup>	quarterly, annual	1946-1968	-2.6255	--	0.5895	0.8914	0.2336	0.571	--
Carman and Maetzold (1971) <sup>e</sup>	quarterly	1949-1967	Q1: -2.08* Q2: -2.06* Q3: -1.27* Q4: -1.99*	-- -- -- --	Q1: 0.93* Q2: 0.63* Q3: 0.16 Q4: 1.52*	Q1: 0.04 Q2: 0.74* Q3: -0.28 Q4: -0.03	Q1: 0.14 Q2: 0.35* Q3: 0.41* Q4: 0.05	0.571 0.571 0.571 0.571	-- -- -- --

<sup>a</sup> 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.

<sup>b</sup> Estimated coefficient positive but not statistically significant. Elasticity not reported.

<sup>c</sup> 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.

<sup>d</sup> 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.

<sup>e</sup> Coefficients estimated subject to constraint of the income coefficient taken from George and King (1971).

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 cross-price elasticities with respect to beef among recent studies is even narrower (0.5 to 0.6). Neither pork nor poultry have 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 et al. (1993), and Williams, Capps, and Dang (2010), find that income is not a significant driver of lamb consumption. Shiflett et al. (2007) 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 colinearity of the income and trend variables used in their analysis as indicated 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.

Both Byrne, et al. (1993) and Shiflett et al. (2007) 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<sup>1</sup>. 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. Williams, Capps, and Dang (2010) estimated the advertising elasticity for lamb to be 0.0386. This work is the only previously published work dealing with calculating this elasticity. 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.

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

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<sup>1</sup> The econometric model and analysis were authored by Douglas D. Heady, included as an Appendix to the Williams et al. (2008) study.

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 soy oil demands to be 0.046, 0.034, and 0.029, respectively.

Using a benefit-cost analysis approach, most studies conclude that checkoff programs increase sales revenues (net of the cost of promotions) or producer 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.

## **METHODOLOGY AND DATA**

To address the effect of advertising and promotion on U.S. lamb demand, we utilize a single-equation structural model expressed as:

$$(1) \quad C_t/POP_t = f(P_t/I_t, P_i/I_t, Y_t/POP_t/I_t, E_t/I_t) + v_t$$

where  $t$  = the current year;  $P$  = 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  $v_t$  corresponds to the error or

disturbance term. By controlling the effects of all economic factors other than the lamb checkoff program, we are in position to isolate and to measure the change in lamb consumption attributable to promotion expenditures.

For estimation, we adopt the use of logarithmic transformations for all variables in the model except for lamb promotion expenditures. This transformation is not possible for lamb promotion expenditures due to the presence of zero values 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 (Kinnucan and Zheng, 2005). The use of logarithmic transformations in econometric analysis also is common practice, especially in more easily obtaining estimates of elasticities.

To allow for the possibility of carryover effects of lamb advertising and promotion, we employ polynomial distributed lag (PDL) formulation. The search for the pattern and time period over which lamb promotion affected U.S. lamb demand involved a series of regressions. For the PDL, up to fourth degree polynomials with lags of up to four years were considered along with alternative choices of head and tail (endpoint) restrictions. Based on the Akaike Information Criterion (AIC), the Schwarz Information Criterion (SIC), and the Hannan-Quinn Criterion (HQC), a second order PDL of lag length of one year with endpoint constraints was selected. As well, a model with contemporaneous promotion expenditures also was selected. Consequently, this analysis rests on the estimation of two econometric models with slightly different specifications concerning the lamb expenditure variables. The use of these two specifications allows us to check on the robustness of the econometric results.

The analysis utilizes annual historical data for fiscal years 1978/79 through 2009/10. The data are available from the authors upon request. Data for per capita lamb consumption (C/POP) are available from USDA (USDAa, 2010) while retail prices (P and  $P_i$ ) are from the Livestock Marketing Information Center (LMIC, 2010) and the Bureau of Labor Statistics (USDL, 2010). Data for personal disposable income (Y), population (POP), and inflation (I) are provided by the Federal Reserve Bank (FRB, 2010). 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 2010). Lamb promotion expenditures over 1978/79 through 2001/02 were provided by ASIA.

Similar to Willaims, Capps, and Dang (2010) as well as Williams, Capps, and Palma (2008), we use the results of the lamb demand estimation to calculate the benefit-cost ratio (BCR) attributable to promotion activities. 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:

$$(2) \quad C_t^A - C_t^Z = [e \text{ PER}_t^A] \text{POP}_t$$

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;  $\text{PER}^A$  = 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:

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

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:

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

where  $P^A$  = the actual retail price of lamb.

In equation (4) we calculate 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 estimate of the portion of the retail level returns to lamb advertising and promotion that accrues to lamb producers, we follow the practice of applying the USDA estimates of the shares of the retail dollar earned by producers to the results derived from equation (4) (Williams, Capps, and Palma, 2008; Williams, Capps, and Dang, 2010).

## EMPIRICAL RESULTS

The respective lamb demand models explain roughly 85% to 88% of the variability in per capita lamb consumption over the 1978/79 to 2009/10 period of analysis (Table 2 and Table 3). The respective models were estimated as well over various time periods to check on the stability of the results. The summary of this recursive exercise is exhibited in Table 4. Significant economic influences on lamb consumption include lamb price; beef and pork prices; and advertising and promotion expenditures. Neither income nor broiler (chicken) prices was a key driver of lamb consumption. These results are consistent with the extant literature.

The estimated own-price elasticity of lamb was in the interval of -0.65 to -0.73, meaning that for every 10% change in the inflation-adjusted lamb price, lamb consumption changes by 6.5% to 7.3% in the opposite direction. Thus, the demand for lamb is inelastic (relatively unresponsive to price). As exhibited by Table 4, this result is in agreement with previous analyses as well as the literature, although we note a drop in the magnitude of the own-price elasticity over time.

The cross-price elasticity for beef was in the interval of 0.27 to 0.31, and the cross-price elasticity for pork was in the interval of 0.31 to 0.49, meaning that a 10% increase in beef price leads to a 2.7% to 3.1% increase in lamb consumption, and a 10% increase in pork price leads to

**Table 2. Econometric Model with Polynomial Distributed Lag Specification of Inflation-Adjusted Promotion Expenditures**

Dependent Variable: LOG(PCLAMBCONS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.162229	3.159386	0.684382	0.5000
LOG(RRETLAMBPRICE)	-0.725807	0.205433	-3.533052	0.0016
LOG(RRETBEFFPRICE)	0.306197	0.224858	1.361736	0.1854
LOG(RRETPORKPRICE)	0.488226	0.216242	2.257772	0.0329
LOG(RPCDSPI)	-0.199799	0.233749	-0.854759	0.4008
PDL01	0.001212	0.000817	1.482488	0.1507
R-squared	0.847081	Mean dependent var		0.216632
Adjusted R-squared	0.816497	S.D. dependent var		0.142276
S.E. of regression	0.060947	Akaike info criterion		-2.585631
Sum squared resid	0.092864	Schwarz criterion		-2.308085
Log likelihood	46.07728	Hannan-Quinn criter.		-2.495158
F-statistic	27.69707	Durbin-Watson stat		1.420292
Prob(F-statistic)	0.000000			
Lag Distribution of SQRTRACTLAMBEXP				
	i	Coefficient	Std. Error	t-Statistic
.	0	0.00081	0.00054	1.48249
.	1	0.00081	0.00054	1.48249
	Sum of Lags	0.00162	0.00109	1.48249

where

PCLAMBCONS = Per capita lamb consumption

RRETLAMBPRICE = Real retail price of lamb

RRETBEFFPRICE = Real retail price of beef

RRETPORKPRICE = Real retail price of pork

RPCDSPI = Real per capita personal disposable income

SQRTRACTLAMBEXP = Square root of real advertising and promotion expenditures of lamb

**Table 3. Econometric Model with Contemporaneous Specification of Inflation-Adjusted Promotion Expenditures**

Dependent Variable: LOG(PCLAMBCONS)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.449553	4.239853	1.049459	0.3044
LOG(RRETLAMBPRICE)	-0.645158	0.274235	-2.352571	0.0272
LOG(RRETBEEFPRICE)	0.268269	0.292204	0.918089	0.3677
LOG(RRETPORKPRICE)	0.310768	0.210527	1.476141	0.1529
LOG(RPCDSPI)	-0.358279	0.319139	-1.122643	0.2727
SQRTRACTLAMBEXP	0.001715	0.000853	2.011663	0.0556
AR(1)	0.407036	0.222878	1.826274	0.0803
R-squared	0.876323	Mean dependent var		0.216632
Adjusted R-squared	0.845404	S.D. dependent var		0.142276
S.E. of regression	0.055941	Akaike info criterion		-2.733349
Sum squared resid	0.075106	Schwarz criterion		-2.409546
Log likelihood	49.36692	Hannan-Quinn criter.		-2.627798
F-statistic	28.34231	Durbin-Watson stat		1.849221
Prob(F-statistic)	0.000000			
Inverted AR Roots	.41			

where

PCLAMBCONS = Per capita lamb consumption

RRETLAMBPRICE = Real retail price of lamb

RRETBEEFPRICE = Real retail price of beef

RRETPORKPRICE = Real retail price of pork

RPCDSPI = Real per capita personal disposable income

SQRTRACTLAMBEXP = Square root of real advertising and promotion expenditures of lamb

Table 4. Empirical Results Concerning the Evaluation of the Lamb Checkoff Program

MODEL SPECIFICATION:  
 POLYNOMIAL DISTRIBUTED LAG: ORDER 2, LAG LENGTH 1, ENDPOINT RESTRICTIONS  
 SQUARE ROOT TRANSFORMATION

TIME PERIOD	OWN-PRICE ELASTICITY	CROSS-PRICE ELASTICITY WRT BEEF	CROSS-PRICE ELASTICITY WRT PORK	ADVERTISING AND PROMOTION ELASTICITY	AIC	SIC	HQC	R2	DW
1978/79 TO 2001/02	-0.8611	0.4304	0.4657	0.0419	-2.7541	-2.4579	-2.6796	0.8327	1.6243
1978/79 TO 2002/03	-0.8093	0.4434	0.4675	0.0446	-2.7668	-2.4722	-2.6886	0.8367	1.5454
1978/79 TO 2003/04	-0.7867	0.6257	0.4701	0.0470	-2.7115	-2.4190	-2.6304	0.8208	1.4350
1978/79 TO 2004/05	-0.8150	0.5406	0.4428	0.0371	-2.6824	-2.3921	-2.5988	0.8287	1.6332
1978/79 TO 2005/06	-0.8143	0.5209	0.4465	0.0363	-2.7306	-2.4426	-2.6449	0.8411	1.6410
1978/79 TO 2006/07	-0.8112	0.5123	0.4473	0.0359	-2.7821	-2.4966	-2.6948	0.8498	1.6428
1978/79 TO 2007/08	-0.8138	0.5258	0.4429	0.0357	-2.8292	-2.5463	-2.7406	0.8568	1.6407
1978/79 TO 2008/09	-0.7662	0.4094	0.4486	0.0361	-2.7379	-2.4576	-2.6482	0.8537	1.6390
1978/79 TO 2009/10	-0.7258	0.3062	0.4882	0.0381	-2.5856	-2.3081	-2.4952	0.8471	1.4203

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MODEL SPECIFICATION:  
 NO POLYNOMIAL DISTRIBUTED LAG: CONTEMPORANEOUS SPECIFICATION  
 SQUARE ROOT TRANSFORMATION

TIME PERIOD	OWN-PRICE ELASTICITY	CROSS-PRICE ELASTICITY WRT BEEF	CROSS-PRICE ELASTICITY WRT PORK	ADVERTISING AND PROMOTION ELASTICITY	AIC	SIC	HQC	R2	DW
1978/79 TO 2001/02	-0.8037	0.3849	0.4127	0.0463	-2.7910	-2.4454	-2.7041	0.8522	2.0560
1978/79 TO 2002/03	-0.7138	0.4765	0.3425	0.0333	-2.7573	-2.4137	-2.6662	0.8483	2.0759
1978/79 TO 2003/04	-0.6872	0.5700	0.3369	0.0366	-2.8073	-2.4660	-2.7126	0.8497	2.1627
1978/79 TO 2004/05	-0.7381	0.4578	0.3388	0.0385	-2.7707	-2.4320	-2.6732	0.8548	2.0096
1978/79 TO 2005/06	-0.7381	0.4577	0.3388	0.0382	-2.8284	-2.4924	-2.7285	0.8662	2.0699
1978/79 TO 2006/07	-0.7409	0.4641	0.3392	0.0377	-2.8830	-2.5499	-2.7812	0.8736	2.0680
1978/79 TO 2007/08	-0.7417	0.4780	0.3349	0.0374	-2.9322	-2.6022	-2.8289	0.8795	2.0633
1978/79 TO 2008/09	-0.6848	0.3302	0.3390	0.0402	-2.8294	-2.5024	-2.7248	0.8751	1.9305
1978/79 TO 2009/10	-0.6452	0.2683	0.3108	0.0404	-2.7333	-2.4095	-2.6278	0.8763	1.8492

a 3.1% to 4.9% increase in lamb consumption, holding all other factors constant. The positive cross-price elasticities with respect to beef and pork leads to a conclusion that beef and pork are substitute meat products for lamb. From Table 4, the cross-price elasticity with respect to beef is on the decline, while the cross-price elasticity with respect to pork is rather stable.

The advertising and promotion elasticities (the estimated responsiveness of lamb demand to changes in promotion and advertising expenditures) varied from 0.038 to 0.040 between 1978/79 to 2009/10, regardless of the model specification.

On the basis of Table 4, the elasticity has remained relatively constant over various time periods. From the estimated elasticity of advertising and promotion, we may conclude that doubling ALB lamb promotion expenditures in any given year would boost lamb consumption roughly 4%.

### **BENEFIT-COST ANALYSIS**

The statistical results imply that the Lamb Checkoff Program indeed increased the total volume of lamb consumed, all other factors invariant. 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 between 7.09 and 7.50, meaning that from its inception through 2009/10, the ALB advertising and promotion program has generated roughly 7.09 to 7.50 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 \$37.16 to \$39.34 for every dollar spent on promotion.

Over the pre-ALB period of 1978/79-2001/02, advertising and promotion efforts translated into 5.06 to 5.36 additional pounds of total lamb consumption per dollar spent on promotion and \$24.30 to \$25.72 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 revenues generated at the retail level actually reaches lamb producers. For various 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 farm share of the retail dollar spent on beef to be about 45.8% on average between 2004 and 2009 (USDAb, 2010). For pork, the estimated share was lower at 29.2% 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 would be between \$17.03 and \$18.02 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 between \$10.84 and \$11.47 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 \$3.72 to \$3.93 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 notable return. In fact, however, nominal ALB advertising and promotion expenditures dropped steadily from \$2.68 million in 2003/04 to \$1.30 million in 2006/07 before rising slightly to \$1.65 million in 2007/08. In 2008/09 and 2009/10, nominal ALB advertising and promotion expenditures were \$1.38 million and \$1.39 million respectively. The calculated BCR for lamb suggests a non-negligible 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, generating an impressive return to producers per dollar spent on promotion. In fact, Williams, Capps, and Dang (2010) demonstrated that promotion efforts enhanced the demand for American Lamb in particular. 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 to 7.5 lbs per dollar spent on promotion, an increase of less than 3% per year. Past promotion efforts over the 1978/79-2001/02 period also were effective in enhancing lamb demand but at a 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 \$37.16 to \$39.34 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 checkoff programs.

It is important to continue to monitor changes in retail lamb consumption due to promotional efforts. In this vein, we plan to continue to update our database and our analysis on a quarterly basis. As previously mentioned, we plan to move to a quarterly demand model for lamb as opposed to an annual model. The quarterly demand model will allow us to more appropriately focus only on the ALB advertising and promotion expenditures exclusively made since July 2002.

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