IS LAMB PROMOTION WORKING?

Oral Capps, Jr.
Gary W. Williams*

TAMRC Commodity Market Research
Report No. CM-01-07
November 2007

* Capps is Professor of Agricultural Economics and Southwest Dairy Marketing Endowed Chair; Williams is Professor and the Director of the Texas Agribusiness Research Center, both of the Department of Agricultural Economics, Texas A&M University, College Station, Texas 77843-2124.

IS LAMB PROMOTION WORKING?

Texas Agribusiness Market Research Center (TAMRC) Commodity Market Research Report No. CM-01-07 by Dr. Oral Capps, Jr. and Dr. Gary W. Williams.

ABSTRACT

This objective of this study is to determine whether the advertising and promotion dollars collected and spent by the American Lamb Board on lamb promotion since the inception of the Lamb Checkoff Program have effectively increased lamb consumption in the United States. The main conclusion is that program has resulted in roughly 7.6 additional pounds of total lamb consumption per dollar spent on advertising and promotion and $41.59 in additional lamb sales per dollar spent on advertising and promotion.

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.

The **Texas Agricultural Market Research Center (TAMRC)** *has been providing timely, unique, and professional research on a wide range of issues relating to agricultural markets and commodities of importance to Texas and the nation for over thirty-five years.* **TAMRC** *is a market research service of the Texas Agricultural Experiment Station and the Texas Agricultural Extension Service. The main* **TAMRC** *objective is to conduct research leading to expanded and more efficient markets for Texas and U.S. agricultural products. Major* **TAMRC** *research divisions include International Market Research, Consumer and Product Market Research, Commodity Market Research, Information Systems Research, and Contemporary Market Issues Research.*

EXECUTIVE SUMMARY

The level of demand and the changes in that level over time are key determinants of the long-run economic viability of any industry. Likewise, understanding and promoting demand are necessary to achieve industry growth and enhance industry profits. Given the struggle of the U.S. sheep and lamb industry since at least the mid-1940s against a long list of competitive pressures, growth of lamb demand is a critical need for the future growth and development of the entire industry. An initial industry effort to promote lamb demand began in 1955 with funds from the Wool Incentive Program. When the Wool Incentive Program and, thus, expenditures for the promotion of lamb were phased out in 1996/97, an unsuccessful effort was made that year to pass a mandatory checkoff program through a producer referendum. The only funds made available for lamb promotion after the phase-out of the Wool Incentive Program until the establishment of the current Lamb Checkoff Program in 2002/03 was through a special grant resulting from a 201-trade complaint that funded about $4.8 million in lamb marketing and promotion projects between 2000/2001 and 2002/2003.

The current Lamb Checkoff Program was established through the Lamb Promotion, Research, and Information Order under the Commodity Promotion, Research and Information Act of 1996 following calls by virtually all segments of the domestic sheep and lamb industry for the establishment of a checkoff program to enhance demand and, thus, to help revive the economic fortunes of the industry. Initiated on July 1, 2002, the Lamb Checkoff Program is funded through the collection of assessments on the sale sheep and lambs. The 13-member American Lamb Board (ALB) that administers the program includes six producers, three packers or first handlers, three feeders and one seedstock producer, all appointed by the U.S. Secretary of Agriculture.

Is the Lamb Checkoff Program working? Have the checkoff assessments paid by the industry and invested by the ALB in lamb advertising and promotion activities effectively increased lamb consumption in the United States? Have any benefits of the program in terms of increased industry revenues been sufficient to outweigh the costs of the program? This report addresses these important questions through a statistical analysis of 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 the ALB advertising and promotion program. The results of that analysis are then used to calculate the benefit-cost ratio (BCR) for the program.

The analysis utilizes historical data and statistical procedures (regression analysis) to measure the effect of advertising and promotion on lamb consumption. All possible relevant economic factors affecting lamb consumption are considered, including: (1) the retail price of lamb; (2) the retail prices of beef, pork, and chicken; (3) disposable personal income; (4) population; (5)

inflation; and (6) advertising and promotion expenditures for lamb. The analysis controls for the effects of all economic factors other than the lamb checkoff program and, thus, isolates the specific impacts of advertising and promotion on lamb. The results allow the measurement of the change in lamb consumption (and lamb sales at fixed prices) attributable to advertising and promotion dollar expenditures, holding all other factors constant.

The main conclusion from this analysis is that the Lamb Checkoff Program is working to increase the demand for lamb at a highly positive benefit-cost ratio. Specific conclusions include the following:

- Doubling inflation-adjusted ALB lamb promotion expenditures in any given year would boost lamb consumption by 3.94%.

- The ALB lamb promotion program has resulted in roughly 7.6 additional pounds of total lamb consumption per dollar spent on advertising and promotion and $41.59 in additional lamb sales revenue per dollar spent on advertising and promotion. Even if the share of the retail sales dollar earned by lamb producers was quite low, this level of retail sales earnings indicates a relatively high return to lamb producers from the Lamb Checkoff Program.

- The high return to lamb promotion implies that the Lamb Checkoff Program is underfunded. However, lamb checkoff assessment revenues and, thus, expenditures on advertising and promotion have been declining in recent years. Given the high estimated BCR for lamb promotion, the reduction in promotion expenditures over the last several years translates into a sizeable opportunity cost to the lamb industry in terms of lost industry revenues.

- 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. In other words, the programmatic activities of the ALB have been relatively more successful in stimulating lamb than past promotional efforts.

IS LAMB PROMOTION WORKING?

The level of demand for lamb and the changes in that level over time are key determinants of the long-run economic viability of the lamb industry. Demand considerations assist in determining the long-range price outlook and provide the foundation for long-range investment decisions. In the livestock and poultry sectors, the demand for a product at the producer level is a *derived* demand, meaning that the demand for the live animals at the farm level is derived from the consumer demand for meat and other livestock products at the retail level. Changes in demand for meat and other livestock products at the consumer level are transmitted down the marketing channel to the producer.

Understanding and promoting demand are necessary for the expansion of any industry. By definition, demand is a schedule of the quantities that consumers are willing to buy at various prices at a given point in time in a particular market. The focus here is on lamb demand by consumers over the entire U.S. market and the programs funded by the lamb check-off program to promote that demand. 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 following calls by virtually all segments of the domestic sheep and lamb industry for the establishment of a checkoff program to enhance demand.

Initiated on July 1, 2002, the Lamb Checkoff Program is funded through the collection of assessments on the sale of sheep and lambs. The 13-member American Lamb Board (ALB) that administers the Lamb 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.

Is the Lamb Checkoff Program working? Have the checkoff assessments paid by the industry and invested by the ALB in lamb advertising and promotion activities effectively increased lamb consumption in the United States? Have any benefits of the program in terms of increased industry revenues been sufficient to outweigh the costs of the program? This report addresses these important questions through a statistical analysis of 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 the ALB advertising and promotion program. The results of the analysis are then used to calculate the benefit-cost ratio (BCR) for the program.

LAMB ADVERTISING AND PROMOTION

The current national lamb demand advertising and promotion programs are administered by the American Lamb Board (ALB) through the Lamb Promotion, Research, and Information Order as authorized under the Commodity Promotion, Research, and Information Act of 1996. The Board meets at least three times per year to establish goals and budgets for new lamb promotion

programs and to evaluate the success of past promotional efforts. Board policies are implemented by a three-member staff in Denver, Colorado. Under the Order, lamb promotion programs are funded by an assessment on the sale all feeder and market lambs and all breeding stock and cull animals. In general, the purchaser collects the assessment, referred to as a "checkoff", with a deduction from the sales proceeds of the seller. The checkoff funds are then carried forward to the point of slaughter or export at which time they are transmitted to ALB. Those whose sales are subject to the checkoff assessment include producers, seedstock producers, exporters, feeders, direct marketers, ethnic slaughter operations, custom slaughter clients, and slaughter/packing plants (ALB 2007). Imported sheep and lambs are assessed on weight gained in the United States. The import checkoff assessment is collected from the domestic producer, seedstock producer, or first handler who takes possession of the imported animals. If sheep or lambs are imported into the United States for immediate slaughter, there is no weight assessment at the time of slaughter.

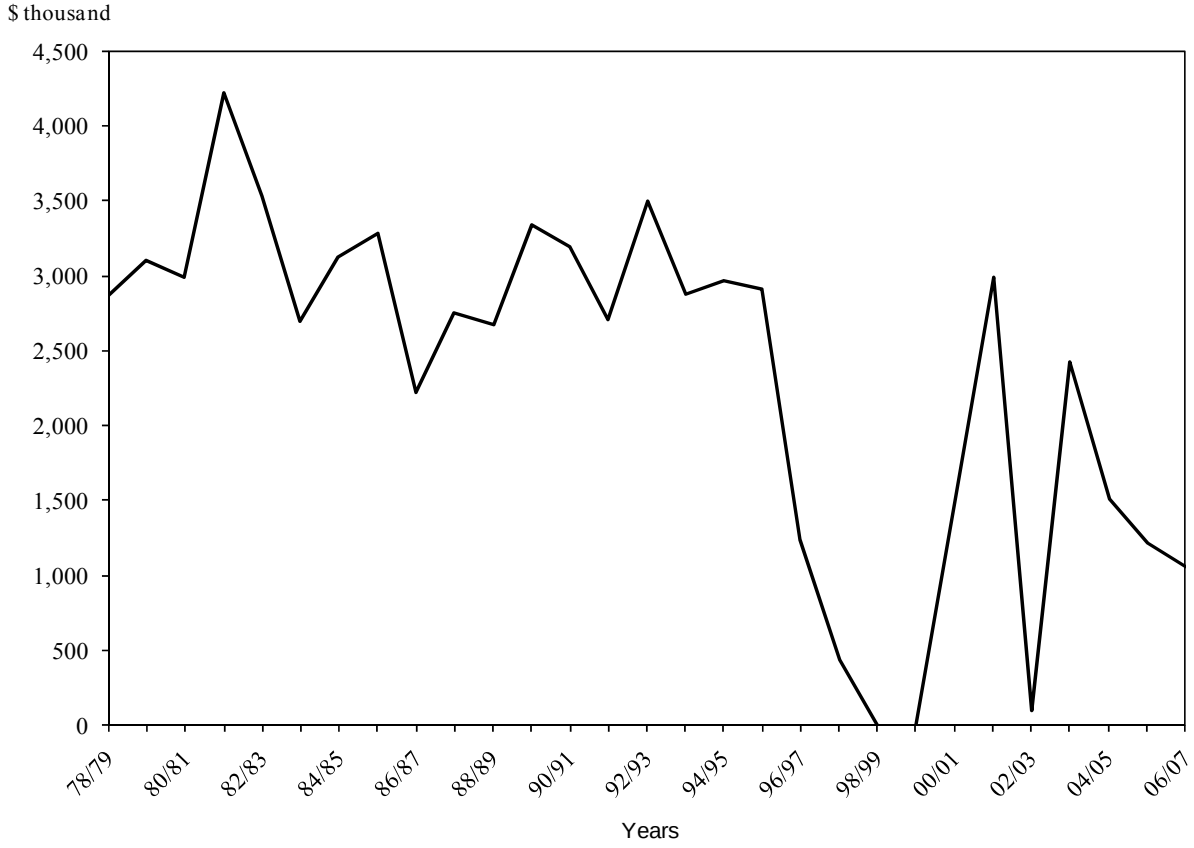
The lamb checkoff assessment is $0.005/pound of live lambs (ovine animals of any age) sold by producers, seedstock producers, exporters, and feeders. For lambs purchased for slaughter by first handlers, the assessment is $0.30/head. A first handler is defined as an entity that takes possession of the lambs for slaughter (including custom or ethnic slaughter) or sale directly to the consumer. First handlers are primarily packing plants but also include some producers, feeders, and direct marketers.

Marketing agencies (sale barns) are not assessed a checkoff fee but must collect the checkoff assessments from the sellers and pass them on to the purchasers. Direct marketers, those who are both producers and first handlers, and those who process and market lamb or lamb products are assessed $0.005/lb on the live weight at the time of slaughter and must pay an additional assessment of $0.30 per head. Each producer, feeder, or seedstock producer is obligated to pay their shares of the assessment. The assessment is passed on to subsequent purchasers until it reaches the first handler or exporter who then remits the total assessment to ALB. A person who is both producer and first handler is responsible for the remittance.

Since the inception of the lamb checkoff program in July 2002, annual nominal advertising and promotion expenditures by ALB have totaled about $7.33 million, an average of about $1.47 million per year. On an inflation-adjusted basis, ALB expenditures in 2002/03 amounted to only $96,035 but rose to $2,433,196 in 2003/04, dropped to $1,518,235 in 2004/05, dropped again to $1,215,240 in 2005/06, and dropped once more to $1,064,682 in 2006/07 (Figure 1). 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 of the administration of the program. All activities funded with checkoff dollars must comply with the Act and the Order and must be approved by USDA.

Before the current Lamb Checkoff Program was approved as a mandatory program, the American Lamb Council of the American Sheep Industry Association, Inc. (ASIA) operated a lamb promotion program using funds made available under the Wool Incentive Program. Between 1978/79 and 1996/97, inflation-adjusted annual expenditures on lamb promotion by ASIA ranged between a high as $4.2 million in 1981/82 and a low of $1.2 million in 1996/97 (Figure 1).

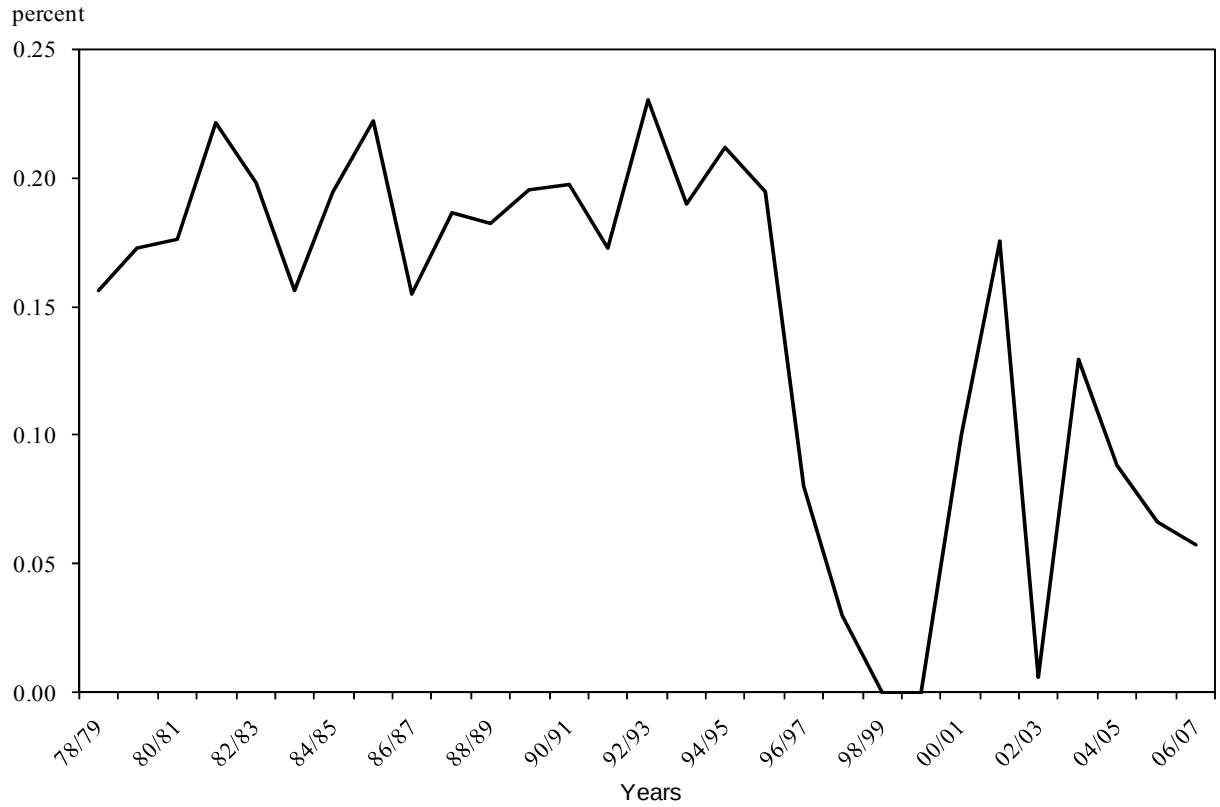
Figure 1: Inflation-Adjusted Advertising and Promotion Expenditures, 1978/79-2006/07



When the Wool Incentive Program and, thus, expenditures for the promotion of lamb were phased out in 1996/97, an unsuccessful effort was made that year to pass a mandatory checkoff program through a producer referendum. The only funds made available for lamb promotion after the phase-out of the Wool Incentive Program in 1995/96 and the establishment of the current Lamb Checkoff Program in 2002/03 was through a special grant resulting from a 201-trade complaint. In 1999/2000, domestic petitioners alleged injury to the U.S. lamb industry from imports. The U.S. International Trade Commission ruled in favor of the domestic complainants. As a result, a lamb import tariff 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.

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. As shown in Figure 2, the lamb advertising-to-sales ratio (often referred to as the investment intensity ratio) over the 1978/79 to 2006/07 period ranged from a minimum of zero in 1999/2000 and 2000/01 to a high of 0.23% in 1992/93 and averaged 0.14% over the entire period. In other words, the amount of checkoff funds spent to promote lamb consumption each year has been no more than

Figure 2: Lamb Advertising to Sales Ratio, 1978/79-2006/07



about one quarter of 1% of the value of lamb sales in any year, 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 since the establishment of the lamb checkoff program, primarily because less has been collected than what was formerly spent on lamb promotion by the ASIA under the Wool Incentive Program. The annual lamb sales-to-advertising ratio between 2002/03 and 2006/07 averaged 0.07% compared to 0.19% between 1978/79 and 1995/96 when the ASIA was responsible for generic lamb promotion efforts.

ALB checkoff advertising and promotion programs are aimed at expanding consumption 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 import competitors; (4) minimizing the volatility of seasonal product sales through targeted promotions; (5) promoting the use of the whole lamb – using all cuts; and (6) leveraging and expanding ALB resources through cooperative relationships with marketing partners.

PREVIOUS RESEARCH

Analyses of national lamb demand typically attempt to quantify how sensitive consumers are to lamb prices as consumption moves from one point to another along the demand curve and to

determine not only if shifts have occurred in lamb demand but also why such shifts have occurred. The results are the bases of appropriate recommendations to improve the profitability of all segments of the lamb industry. Raising the demand for lamb is a key to the growth and expansion of the industry. Increasing demand translates into consumers purchasing more lamb at constant or higher prices, which in turn, improves the economic viability of the entire sheep and lamb industry.

Despite its importance in potentially fostering growth and profitability in the sheep and lamb industry, research focused on understanding the economic determinants of U.S. lamb demand has been limited. Shiflett et al (2007) provide a summary of prior lamb demand studies, including Byrne, Capps, and Williams (1993); Capps and Williams (2005); Purcell (1989); and Schroeder et al (2001). 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 the elasticities of demand with respect to those demand drivers, including primarily the own-price, cross-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 prices of beef and pork, and seasonality. Most studies have concluded that income has not been a statistically significant driver of changes in lamb demand. All but one study (Capps and Williams, 2005) have ignored the lamb demand effects of lamb advertising and promotion programs.

The own-price elasticity measures the percentage change in consumption of a particular product due to a one percent change in its own price, all other factors invariant. Theory suggests that the own-price elasticity is always negative, indicating an inverse relationship between the retail level of consumption of a product and its market price. The greater the magnitude of the own-price elasticity (in absolute value), the greater the sensitivity of consumers to changes in the price. An elasticity measure greater than one in absolute value is considered "elastic" meaning that a given percent change in price results in a larger percent change in quantity demanded. In this case, demand is considered to be highly responsive to price changes. Also, if the demand for any product is elastic, then a price discount (increase) generates not only a larger percentage increase (decrease) in the quantity consumed but also an increase (a decrease) in total revenue to the seller. On the other hand, an elasticity measure less than one in absolute value is considered "inelastic" meaning that a given percent change in price results in a smaller percent change in demand. Thus, demand is relatively unresponsive to price changes. For a product whose demand is inelastic, a price discount (increase) leads to not only a smaller percentage decrease (an increase) in consumption but also a decrease (an increase) in total seller revenue.

Cross-price elasticities of demand refer to the percentage change in the consumption of one good due to a one percent change in the price of another good. If this measure is positive, then the two goods are considered substitutes. On the other hand, if this measure is negative, then the two goods are considered complements. If the cross-price elasticity is not statistically different from zero, then the two goods are considered to be independent. While a change in own-price moves consumption along the demand curve, a change in the price of a substitute or complement actually shifts the demand curve (the cross-price effect), all other factors invariant.

Income elasticity refers to the sensitivity of consumer purchases with respect to changes in income. With changes in income, the demand curve shifts as well, holding all other factors constant. The income elasticity of demand, by definition, is the percentage change in quantity demanded attributed to a one percent change in income, al other factors invariant.

The estimated own-price elasticities of per capita lamb demand across most studies have been close, ranging from -0.5 to -0.8 despite the time period analyzed (Table 1). In other words, research provides evidence that there is an inverse relationship between retail lamb price and the quantity of lamb purchased and that the relationship is inelastic implying that lamb demand is not highly responsive to price changes. Those studies which included more recent data, especially data after 1999, indicted a higher degree of elasticity (more sensitivity to price) than those studies using earlier data. This suggests that lamb consumers may have become somewhat more sensitive to changes in price over time in terms of their willingness to buy or not buy lamb based on its price.

Most studies have found a statistically significant substitute relationship between lamb and beef and between lamb and pork (Table 1). The estimated cross-price elasticities of lamb demand with respect to beef and pork price across most studies are also close, ranging from 0.5 to 0.6 for beef and from 0.1 to 0.4 for pork. At the same time, all but one study (RTI 2007) conclude that lamb and chicken are independent commodities in consumption. Those studies using the most current data show greater substitutability between lamb and the other meats, although the relationships are not consistent across studies.

Also, all but one study (Shiflett et al., 2007) conclude that income is not a statistically significant driver of lamb consumption. Shiflett et al. (2007) initially found that income is statistically insignificant in explaining changes in per capita lamb demand but then added a trend variable to the model and found a positive and statistically significant relationship between per capita lamb demand and income suggesting the possibility of bias due to collinearity of the income and trend variables they used. The lack of broad evidence of a statistically significant relationship between income and lamb purchases may be the result of either the relatively small amount of lamb purchased or the fact that most lamb is purchased for special occasions which traditionally feature lamb.

Seasonality is another variable that all studies using at least quarterly data have found to be a statistically significant determinant of per capita lamb demand. Lamb consumption typically is highest in the first and fourth quarter of the year (for example, see Byrne, Capps, and Williams (1993) and Shiflett et al (2007)).

To date, Capps and Williams (2005) is the only study that has analyzed the responsiveness of lamb demand to the advertising and promotion activities that have occurred over the years. They developed an econometric model of lamb demand in which the effects of current and past lamb advertising and promotion efforts on U.S. lamb consumption at the retail level of the marketing channel were included using data for the 1978/79-2004/05 time period. The analysis controls for the effects of the primary economic factors other than the lamb checkoff program that drive lamb demand, including: (1) the retail price of lamb; (2) the retail prices of beef, pork, and chicken; (3) disposable personal income; (4) population; and (5) inflation. In this way, the analysis isolates

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

Study	Time period of analysis	Own price	Cross-price				Per capita Income
			Import lamb	Beef	Pork	Chicken	
RTI (2007)	1970-2003	-0.523	0.293	ns	ns	0.35	Ns
Shiflett et al. (2006)	1980-2005	-0.665	--	0.486	0.179	ns	0.684
Capps, Williams (2005)	1978-2004	-0.807	--	0.533	0.389	ns	Ns
Schroeder et al. (2001)	1978-1999	-1.09	--	0.57	ns	ns	-0.54
Byrne, et al. (1993)	1978-1990	-0.62	--	ns	0.131	ns	Ns
Purcell (1989)	1970-1987	-0.51	--	ns	ns	ns	Ns

[a] The 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).
Note: ns = not statistically significant and -- = not considered in the analysis.

the specific impacts of advertising and promotion on lamb demand and allows a measurement of the change in lamb consumption (and lamb sales at fixed prices) attributable to advertising and promotion dollar expenditures, holding all other factors constant.

Capps and Williams (2005) incorporated the influence of the lamb advertising and promotion programs into their lamb demand model as a three-period moving average (current period and two lags) of inflation-adjusted advertising and promotion expenditures in the periods both before and after the establishment of the current Lamb Checkoff Program. Using this model, they found that the ALB program had a positive but not highly significant effect on lamb demand. They reported an advertising elasticity of 0.022 in the pre-ALB period (1978/79 through 2001/02) and 0.031 for the current Lamb Checkoff Program (2002/03 through 2004/05). Though small, these advertising elasticities are consistent with those found by many other researchers across a wide variety of agricultural commodity checkoff programs (see Williams and Nichols, 1998). The ALB lamb advertising elasticity implies that a doubling of ALB advertising would boost per capita lamb consumption by 3.1%. Using these statistical results, Capps and Williams (2005) calculated that, between 2002/03 when the lamb checkoff program began and 2004/05, the ALB advertising program had resulted in roughly 8.4 additional pounds of total lamb consumption and $44.60 in additional lamb sales per ALB dollar spent on advertising.

METHODOLOGY AND DATA

Unfortunately, the Capps and Williams (2005) conclusions regarding the effectiveness of the ALB program were based on weak statistical significance of the advertising variable in the model. This study modifies the Capps and Williams model by using a polynomial distributed lag (PDL) process to capture the advertising carryover effects as is commonly done in analyses of commodity checkoff programs. In addition, a square root transformation of the advertising and promotion variable is used in the demand model to allow for both diminishing marginal returns and zero expenditures in advertising expenditures at certain time periods. The model was then re-estimated after adding two additional years of data to the dataset to create a 1978/79 through 2006/07 sample period.

The analysis utilizes annual historical data for fiscal years 1978/79 through 2006/07 and statistical procedures (regression analysis) to measure the effect of advertising and promotion on per capita lamb consumption. To accomplish this task, we consider all possible relevant economic factors affecting lamb consumption (C), including: (1) the retail price of lamb (P); (2) the retail prices of beef, pork, and chicken (P_i); (3) personal disposable income (Y); (4) population (POP); (5) inflation (I); and (6) advertising and promotion expenditures for lamb (E). The general form of the econometric equation used in this analysis 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 t = the current year; i = beef, pork, and chicken; Y = personal disposable income; I = consumer price index; and E = the square root transformation of ALB promotion expenditures.

Data for per capita lamb consumption (C/POP) are available from USDA (2007) while retail prices (P and P_i) are from the Livestock Marketing Information Center (LMIC) and the Bureau of Labor Statistics (BLS). Data for personal disposable income (Y), population (POP), and inflation (I) are provided by the Federal Reserve Bank (FRB). Data for inflation-adjusted lamb advertising and promotion expenditures by the American Lamb Board are available only since July 2002. To insure a sufficient sample size for regression analysis, fiscal year data on advertising expenditures by American Lamb Board since July 2002 are combined with lamb promotion expenditures by the American Sheep Industry Association (ASIA) under the Wool Incentive Program before the implementation of the lamb checkoff program[1]. In the analysis, care is taken to delineate the effects of the advertising and promotion expenditures of the American Lamb Board since July 2002 from previous promotional expenditures made from 1978/79 through 2001/02. Obviously, the more relevant advertising effects for this analysis are those of the current Lamb Checkoff Program.

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 statistical regression technique used allows a measurement of the change in lamb consumption (and lamb sales at fixed prices) attributable to prices, income, and

[1] Data for ASIA promotion expenditures for 1978/79 through 2001/02 were provided by Tom McDonnell of the American Sheep Industry Association.

advertising and promotion dollar expenditures, holding all other factors constant. These measurements are the own-price, cross-price, income, and advertising elasticities associated with the demand for lamb mentioned earlier. Specifically, the elasticities estimated are the percentage changes in the per capita consumption of lamb due to unit percentage changes in inflation-adjusted lamb price, the inflation-adjusted prices of other meats (beef, pork, and chicken), the inflation-adjusted per capita income, and inflation-adjusted advertising and promotion expenditures.

STATISTICAL RESULTS

The structure of the model used in this analysis is identical to the Capps and Williams (2005) model except for the consideration of advertising and promotion expenditures. Diminishing marginal returns to advertising normally observed in checkoff promotion programs was accounted for in the model with the use of a square root transformation of the advertising and promotion expenditures to create the advertising variable used in the analysis. To capture the carryover effects of advertising and promotion, a second degree polynomial of lag length of one year with endpoint constraints was used. The degree of the polynomial and the number of lags were determined through the use of the Akaike Information Criterion (AIC) and the Schwarz Information Criterion (SIC), commonly accepted statistical measures of model selection. The rationale for the consideration of lags in advertising is that its impact may not be felt all at once. The impact of advertising and promotion likely is distributed over time.

The estimated model explains roughly 84% of the variability in per capita lamb consumption over the 1978/79-200/07 period of analysis (Table 2). The parameter estimates indicate that the ALB checkoff program has had a statistically significant effect on per capita lamb consumption. Other statistically significant economic drivers of U.S. lamb consumption were found to be the price of lamb and the prices of beef and pork. Neither income nor the price of chicken was found to have any statistically significant effect on lamb consumption.

The estimated own-price elasticity of lamb is -0.70 meaning that for every 10% change in the inflation-adjusted lamb price, per capita lamb consumption changes by nearly 7% in the opposite direction. Thus, the per capita demand for lamb is price inelastic, or in other words, not overly sensitive to price.

Cross-price elasticities for beef and pork are estimated to be 0.56 and 0.39, respectively, meaning that a 10% increase in beef price leads to a 5.6% increase in per capita lamb consumption and a 10% increase in pork price leads to a 3.9% increase in per capita lamb consumption, holding all other factors constant. The positive cross-price elasticities for beef and pork leads to the conclusion that beef and pork are substitute meat products for lamb. The own-price, cross-price, and income elasticities are consistent with the results of previous research. The income elasticity is estimated at 0.19 but is not statistically different from zero.

Table 2: The Lamb Demand Model[a]

$$LN(PCLC) = -2.887 - 0.700*LN(RPL/CPI99) + 0.562*LN(RPB/CPI99) + 0.394*LN(RPP/CPI99) + 0.193*LN(PCDI/CPI99) + 0.00088*(SRLADV_t) + 0.00088*(SRLADV_{t-1})$$

(3.917) (0.163) (0.231) (0.202) (0.654) (0.00049) (0.00049)

$R^2 = 0.840$ R^2 (adjusted) = 0.804 DW = 1.559

where	PCLC	=	per capita lamb consumption (pounds)
	RPL	=	retail price of lamb ($/lb)
	RPB	=	retail price of beef ($/lb)
	RPP	=	retail price of pork ($/lb)
	PCDI	=	per capita disposable income ($)
	CPI99	=	consumer price index (1999=100)
	SRLADV	=	square root of real lamb advertising and promotion expenditures ($ thousands)

[a] Numbers in parentheses are standard errors.

This analysis constitutes the third updated estimate of the parameters of this lamb demand model with each update adding more recent data to the dataset. Notably, the own-price and cross-price elasticities have been quite stable. That is, they have changed little with each update. However, although not statistically different from zero in this or previous updates, the estimated income elasticity has risen monotonically over the various updates from -0.20 with data through 2002/03 up to 0.19 with data through 2006/07. This rise in the income elasticity may be the result of the growing importance of the food away from home sector to the lamb industry over time.

The lamb promotion expenditure elasticity is estimated to be 0.0394 which is consistent with those of other checkoff commodities. In other words, the statistical results indicate that a doubling of lamb promotion expenditures (that is, a 100% increase) would result in a 3.94% increase in per capita lamb consumption. Using the same model with data for only the 1978/79 to 2001/02 period prior to the existence of the American Lamb Board, the advertising and promotion elasticity was estimated to be 0.0386.

BENEFIT-COST ANALYSIS

Another way to look at the estimated relationship between per capita consumption of lamb and promotion expenditures is to use the statistical results to calculate the benefit-cost ratio (BCR) of the Lamb Promotion Checkoff Program by dividing the benefit of the promotion in terms of additional quantities sold or dollars of revenue earned per dollar spent on promotion. The first step is to use the estimated promotion elasticity to calculate the change in U.S. lamb consumption (C) effected by the Lamb Checkoff Program in any given year as:

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

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:

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

where E_t = annual expenditure on lamb promotion by the ALB.

The Revenue BCR (the additional revenues generated per dollar spent on promotion) is then calculated as:

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

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

Using these formulas, the Lamb Sales BCR is calculated to be 7.56, meaning that through 2006/07 the ALB advertising and promotion program has generated roughly 7.56 additional pounds of total lamb consumption per dollar spent on advertising and promotion. According to equation (4), that translates into additional lamb sales revenue of $41.59 per dollar spent on promotion.

Past promotion efforts over the 1978/79-2001/02 period were effective in enhancing lamb demand as well but less so than the recent activities of the ALB. Over the 1978/79-2001/02 period before the establishment of the ALB and the lamb checkoff program, advertising and promotion efforts translated into 5.56 additional pounds of total lamb consumption per dollar spent and $26.31 in additional lamb sales. Consequently, the programmatic activities of the ALB have been relatively more successful in stimulating lamb than past promotional efforts.

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 estimated 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 2001 and 2006 (USDA 2006). For pork, the estimated share was lower at 28.9% over the same period. If lamb producers earned the same share of the retail dollar as beef producers, then the revenue

BCR from the lamb promotion program at the producer level would be $19.21. 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 $12.02. Even if the share earned by lamb producers was much lower, even at 10% for example, lamb producers would still be earning $4.16 for every dollar invested in the Lamb Checkoff Program, a reasonable return on investment.

These BCRs reflect a relatively high return to the investment made by the lamb industry in promoting lamb demand. The high calculated BCRs provide solid, statistical evidence that the ALB lamb promotion efforts have been highly effective in building demand for lamb. They also imply that the lamb promotion program is 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 checkoff organizations. However, with such a large BCR, the lamb checkoff assessment could be increased substantially and still realize a healthy return. In fact, however, nominal ALB advertising and promotion expenditures have dropped steadily from $2.72 million in 2003/04 to $1.75 million in 2004/05 to $1.45 million in 2005/06 to $1.30 million in 2006/07. Thus, 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 the Lamb Checkoff Program is working to increase the demand for lamb. Specific conclusions include the following:

- Doubling ALB lamb promotion expenditures in any given year would boost lamb consumption by 3.94%.

- The ALB lamb promotion program has resulted in roughly 7.56 additional pounds of total lamb consumption per dollar spent on advertising and promotion and $41.59 in additional lamb sales revenue per dollar spent on advertising and promotion. Even if the share of the retail sales dollar earned by lamb producers was quite low, this level of retail sales earnings indicates a high return to lamb producers from the Lamb Checkoff Program.

- The high return to lamb promotion implies that Lamb Checkoff program is underfunded. However, lamb checkoff assessment revenues and, thus, expenditures on advertising and promotion have been declining in recent years. Given the high estimated BCR 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.

- 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. In other words, the programmatic activities of the ALB have been relatively more successful in stimulating lamb than past promotional efforts.

This 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, it is important to continue to monitor changes in retail lamb consumption due to promotional efforts.

REFERENCES

Byrne, P., O. Capps, Jr., and G.W. Williams, "U.S. Demand for Lamb: The Other Red Meat," *Journal of Food Distribution Research*, February 1995.

Oral Capps, Jr. and G.W. Williams, *Measuring the Effectiveness of Lamb Advertising and Promotion: An Updated Analysis*, Commodity Market Research Report No. CM-01-05, Texas Agribusiness Market Research Center, Texas A&M University, College Station, Texas, September 2005.

Federal Reserve Bank of St. Louis (FRB), Economic Data – FRED, St. Louis, Missouri, 2007. On-line at: http://research.stlouisfed.org/fred2/.

Livestock Marketing Information Center (LMIC), Lakewood, Colorado, data available to members, 2007. On-line at: http://lmic.info/.

Purcell, W.D., "Analysis of Demand for Beef, Pork, Lamb, and Broilers: Implications for the Future", Research Institute on Livestock Pricing, Virginia Tech, Research Bulletin 1089, July 1989.

Schroeder, T.C., R.J. Jernick, R. Jones, and C. Spaeth, "U.S. Lamb Demand," *Sheep and Goat Research Journal*, May, 2001.

Shiflett, J.S., W.D. Purcell, D. Marsh, and P. Rodgers, "Analysis of Lamb Demand in the United States," Report to the American Lamb Board, January 2007.

U.S. Bureau of Labor Statistics (BLS), "Lamb Price Indices," Washington, D.C., 2007. On-line at: http://www.bls.gov.

U.S. Department of Agriculture (USDA), "Food Availability Data System," Economic Research Service, Washington, D.C. Last updated February 15, 2007. On-line at: http://www.ers.usda.gov/data/foodconsumption/FoodAvailIndex.htm.

U.S. Department of Agriculture (USDA), "Food Market Indicators: Farm-to-Retail Price Spreads for Food," Economic Research Service, Washington, D.C., 2006. On-line at: http://www.ers.usda.gov/Data/FoodMarketIndicators/default.asp?TableSet=3

Williams, G.W. and J.P. Nichols, *Effectiveness of Commodity Promotion*, Consumer and Product Market Research Report No. CP-1-98, Texas Agricultural Market Research Center, Texas A&M University, College Station, Texas, May 1998.