Comparative Analysis of Slaughter Lamb Prices

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Abstract: Data on weekly summaries of slaughter lamb sales in 1996 were analyzed to determine price differences for factors affecting lamb prices. Models were compared with a 1991 study and across regions. Demand and supply variables were found important as well as marketing methods, sale lot sizes, seasonal and regional variables.

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Sheep producers successfully urged Congress in 1991 to require the U.S. Department of Agriculture (USDA) to address price discovery in the sheep industry, especially how to improve lamb price and supply reporting (U.S. Department of Agriculture 1992). Some improvements were made by USDA, e.g., in September 1992, USDA began reporting boxed lamb cutout values. However, agricultural economics research on price discovery in the sheep and lamb industry is (*Sheep & Goat Research Journal*).

Limited research has examined the competitiveness of the marketplace in which individual transaction prices are discovered, including the impacts from instituting electronic markets (Ward, 1984). Limited research has also focused on how transaction prices vary over time and how they compare with annual average prices or with prices at other points in the production and marketing channel, e.g. slaughter lamb prices vs. wholesale or retail lamb prices (TAMRC Lamb Study Team 1991). Ward and Hildebrand (1993) used sale summary and transactions data for 1991 to determine factors affecting slaughter lamb prices.

Industry data used by Ward and Hildebrand (1993) was discontinued after sheep producers voted to end the sheep and lamb checkoff program. This paper reports on a study that used the last year of available data, i.e., 1996, to again examine factors affecting slaughter lamb sale summary and transaction prices. Results enable comparing findings for 1996 with findings from the Ward and Hildebrand work for 1991.

Data and Model Development

One type of price discovery research attempts to determine factors that explain the variation in transaction prices. There has been relatively little of this type of research with slaughter lambs because access to transactions data are limited. Factors affecting transaction price variation for slaughter lambs could be expected to parallel those found for fed cattle (Jones et al. 1992; Ward 1992; Schroeder et al. 1993; Ward, Koontz, and Schroeder 1998). Such variables might include: (1) wholesale boxed lamb prices; (2) pelt and byproduct prices; (3) lamb attributes (including weight, quality grade, and yield grade); (4) sale lot size; (5) number of days between purchase and delivery of lambs; (6) number of packers bidding on lambs; (7) individual packing plants or firms; (8) individual lamb feedlots selling lambs; (9) day of the week; (10) time of year; (11) region of the country; and (12) extent and type of packer-controlled supplies. Unfortunately, data for some of these variables are not publicly available.

Data analyzed in this study were slaughter lamb sales reported in the American Sheep Industry Association's weekly *Lamb and Wool Market News* during 1996. Reported sale data included summaries of several transactions but may have also included individual transactions for a given week. Reported data regularly included region and state where lambs were sold, type of marketing method, number of lambs sold, weight range of lambs sold, and the price range for lambs sold. Additional data also were reported in the weekly report, including USDA boxed lamb cutout value for carcasses weighing 65 lbs. or less, U.S. lamb and mutton production, U.S. Federally inspected sheep and lamb slaughter, and pelt price range for No. 1 pelts. Data analyzed

included 1,216 reported summaries of slaughter lamb sales or individual sale lots during 1996.

The general model specified, expressed in implicit form, was

(1) SLP = f (WLCV, PP, PRODN, HD, HD2, LVWT, LVWT2, MKTTYPE, MONTH, REGION).

Variable definitions are: SLP is the midrange price of each reported sales observation of slaughter lambs ($/cwt.); WLCV is the reported weekly lamb cutout value for 65 or less lb. carcasses ($/cwt.), PP is the reported weekly average pelt price for No. 1 pelts ($/pelt), PRODN is the weekly lamb production in the U.S. (million lbs.), HD is number of head for each reported sales observation of slaughter lambs, HD2 is number of head squared, LVWT is the midrange weight of each reported sales observation of slaughter lambs (lbs.), LVWT2 is live weight squared, MKTTYPE is a zero-one dummy variable for marketing method (AUC=Auction, DIR=Direct, COMP=Computer auction, TEL=Teleauction, POOL=Pool), MON is a zero-one dummy variable for month of the year (JAN...DEC), and REGION is a zero-one dummy variable for region (EAST, NORCEN=North Central, SOUCEN=South Central, MOUNTAIN, WEST). Model (1) was modified and estimated for each region, i.e., region dummy variables were dropped, as were market type variables if not used in a given region. Models were estimated by ordinary least squares (OLS) regression using SAS software.

Results and Discussion

Selected summary statistics are shown in Table 1. Slaughter lamb and wholesale lamb prices, the latter measured by the lamb cutout value, varied relatively widely and seasonally throughout 1996. Prices in 1996 were contraseasonal, i.e., peaking in June

rather than April, compared with 1991 and most earlier estimates of seasonal price patterns. Pelt prices began 1996 at a moderately high level, $11/pelt, and increased steadily throughout the year, peaking in November at $16.50/pelt and ending the year at over $15/pelt. Slaughter lamb production peaked in March and was lowest in the June-August period.

Regional differences were noted in average weights of slaughter lambs marketed, sale summary numbers, and types of marketing methods used (Table 1). Slaughter lambs were lightest in the East region and much heavier in the Mountain and West regions. The weight distribution of slaughter lambs in the North and South Central regions were similar.

One difficulty with the data reported is that number of lambs sold may be a summary of several transactions or it may be a single transaction. Thus, number of head marketed per observed data point varied widely. Still, it is clear that slaughter lambs in the East and North Central regions are sold in smaller sale lots than in other regions. The South Central region is a transition region in that it has many smaller sale lots but also several very large sale lots. Sale lots in the Mountain and West regions are much larger than elsewhere in the U.S.

Marketing methods also varied by region. Auctions are the predominant marketing method in the three eastern and midwest regions, while direct marketing is most common in the two western regions. Computer auctions serve producers in the North and South Central regions, while teleauctions are used by producers in the East region. Limited use of slaughter lamb pools were found in four of the five regions but were most common in the East region.

Selected regression results are shown in Table 2. Discussion of results is divided into relationships between slaughter lamb prices and selected independent variables. Results refer to the U.S. model, for data across all regions, and to specific regions.

Demand and Supply Variables

Slaughter lamb prices (SLP) were positively and significantly related to wholesale lamb cutout values (WLCV) in the U.S. model and all regional models. Lamb cutout values in this study served the same role as wholesale carcass prices in the Ward and Hildebrand (1993) study. Slaughter lamb prices were expected to be related to wholesale prices based on the concept of derived demand. The TAMRC Lamb Study Team (1991) found that slaughter lamb prices were more closely associated with wholesale lamb prices than with retail lamb prices. In 1996, a one cent per pound increase in the wholesale lamb cutout value was associated with a $0.32/cwt. increase in slaughter lamb prices.

Slaughter lamb prices were not statistically significantly affected by pelt prices (PP) in any of the models for 1996, contrary to the 1991 data. In one sense this result was surprising, since pelt sales represent the largest component of byproducts income for lambpacking firms. However, as a percent of income from an individual carcass, the pelt makes up about 10-15 percent, thus a relatively small amount. In addition, since pelt prices increased almost linearly through the year, they did not move at all in concert with slaughter lamb prices.

Lamb production was inversely related to slaughter lamb prices in the U.S. model, as is theoretically expected. Results were not consistent for the regional models. The coefficient was negative in most cases but not statistically significant. Federally inspected slaughter was substituted for lamb production with very similar results.

Characteristics of Reported Sales

Number of lambs sold for each reported sale summary or individual sale lot was included in the model in quadratic form (HD and HD2). Often buyers pay a price premium for larger sale lots of livestock but the price premium is expected to decline as sale lot size increases. Thus, a positive coefficient could be expected for the number of head variable (HD) and a negative coefficient for the squared term (HD2). Results confirmed prior expectations and were consistent with the Ward and Hildebrand (1993) study, but in both years the price premium for larger sale lots was small. In the regional models, results differed somewhat. The coefficients carried the expected sign but were not always significant.

Typically, a negative relationship exists between slaughter livestock prices and average live weight for livestock marketed. However, the relationship is not expected to be linear. Live weight was included in the model in quadratic form (LVWT and LVWT2). The weight variables differed as much as any among the estimated models. For the U.S. model, the coefficients had the expected signs, but were not significant, both for 1996 and 1991. In the regional models, results differed widely. The expected coefficient signs switched in some cases (Mountain and West regions) compared with expected signs and were even significant with unexpected signs in the Mountain region. In two other regions, signs and significance were as expected (North and South Central regions).

Marketing Methods

Marketing methods affected prices received for slaughter lambs and varied across regions. Prices received from direct sales (DIR) were considered the base for comparison

purposes. Prices were significantly higher ($2.57/cwt.) for slaughter lambs marketed through computer auctions but were significantly lower (-$1.93/cwt.) for slaughter lambs marketed through teleauctions, another form of electronic market. No significant differences were found between marketing slaughter lambs via auction markets (AUC) or lamb pools (POOL) compared with marketing direct to packers in the U.S. model. Computer auction sales received the highest prices among marketing methods in 1991 also.

Regional results varied, in part because some marketing methods were not used in some regions. Prices at computer auctions were significantly higher than direct sale prices in the two regions where computer auction markets serve lamb producers (North and South Central regions). Slaughter lamb pools received significantly higher prices in two of the three regions where they were used (East and West regions), but significantly lower prices in one of the other two regions (North Central region). Teleauction prices were significantly higher in the East region where they are used most frequently of the five regions, compared with direct sales. Auction market prices were significantly higher in the East and West regions compared with direct sales but were significantly lower in the South Central region and not significantly different in the other two regions. Thus, prices paid varied considerably by marketing method depending on the part of the country where each marketing method was used.

Time of Year

Slaughter lamb prices exhibit a strong seasonal pattern though the pattern has changed somewhat in recent years. For many years, prices were typically highest in the and lowest in the late summer and fall months. Coefficients on the month variables (not

shown in Table 2 for space reasons) confirmed within-year price differences but a somewhat different pattern than has been typical. Slaughter lamb prices in 1996 were highest in the summer months (June, July, and May) and lowest in January and in the late summer through late fall months (August through November). However, it should be noted that since slaughter lamb prices are dependent on wholesale lamb prices combined with other factors, and because data analyzed were for a single year, coefficients on the month variables would not necessarily reflect a long-term seasonal pattern.

Region of the U.S.

Slaughter lamb prices varied within and among regions used by the American Sheep Industry Association in its weekly *Lamb and Wool Market News.* Price differences among and within regions are difficult to explain in a model such as this, especially after accounting for other variables that affect slaughter lamb prices. Spatial price differences may be interrelated with seasonal price differences, type of marketing method, or other region-specific production and marketing practices. The location of major lambpacking facilities and relative proximity to large consumer markets may also affect price differences within and among regions. More research is needed than was possible here to explain regional price differences found in this study.

The North Central region was selected as the base region for comparison purposes. Compared to the North Central region, slaughter lamb prices were significantly higher ($1.18/cwt.) in the Mountain region, significantly lower ($1.10/cwt.) in the West region, and significantly lower ($0.83/cwt.) in the South Central region. No significant difference was found for slaughter lambs sold in the East region compared with the North Central region.

Conclusions

Price discovery models estimated in this study attempted to account for variation in slaughter lamb prices from several sources. Those variables which appeared to be most important in the U.S. model included wholesale lamb prices, lamb production, marketing method, number of head, time of year, and location. The U.S. model explained 72 percent of the variation in reported slaughter lamb prices during 1996; and the regional models, 61-86 percent.

Slaughter lamb prices were directly affected by wholesale lamb cutout values. Therefore, accurate reporting of wholesale lamb prices is important. Slaughter lamb prices were inversely associated with lamb production. Demand and supply factors remain important in explaining short-term slaughter lamb prices.

Within-year price differences and regional differences were important in explaining slaughter lamb prices, just as in the only comparable study of this type. Of particular note is the difference in prices among marketing methods, which also differ among regions of the U.S.

Further price discovery research needs could be identified. While price differences have been noted, this study does not purport to explain the underlying reasons for many price differences. Reasons for some price differences are not well understood and change over time. Thus, more sophisticated analysis is needed to resolve many of the unanswered questions related to price discovery in the sheep and lamb industry.

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Table 1. Summary Statistics for Selected Variables

		Mean	Standard Deviation	Minimum	Maximum
Average Slaughter					
Slaughter Lamb Price	$/cwt.	88.29	9.61	66.00	121.00
Wholesale Lamb Cutout Value	$/cwt.	200.64	13.01	174.03	230.50
Average Pelt Price	$/pelt	13.87	1.33	11.00	16.50
Sheep and Lamb Production	M. lbs	4.64	0.66	3.50	6.90
Federally Inspected Lamb Slaughter	1,000 hd	75.70	10.10	54.00	106.00

	Region				
	East	North Central	South Central	Mountain	West
	(Percent)				
Average Weight (lbs.)					
70-89	2.5	0.2	0.0	0.0	0.0
90-109	30.7	3.6	14.2	3.9	2.4
110-129	63.8	68.0	67.8	36.4	48.2
130-149	3.1	26.7	16.4	54.5	49.4
150-169	0.0	1.5	1.6	5.2	0.0
Number of Head					
Less than 200	39.3	27.6	36.6	6.5	3.6
200-399	34.4	28.5	24.0	13.0	7.2
400-999	25.3	23.6	9.9	48.1	16.8
1,000-4,999	1.8	19.8	18.0	31.2	57.8
5,000 or More	0.0	0.4	11.5	1.3	14.4
Marketing Method					
Auction	59.8	47.4	49.7	6.5	4.8
Direct	15.5	32.0	38.3	80.5	92.8
Computer Auction	0.0	19.3	12.0	0.0	0.0
Teleauction	8.4	0.4	0.0	0.0	0.0
Pool	16.4	0.9	0.0	13.0	2.4

Table 2. Partial Regression Results for the U.S. and by Region.[a]

Independent Variables	U.S.	East	South Central	North Central	Mountain	West
Intercept	32.53**	71.52*	65.68**	69.04***	-171.59**	-46.97
	(0.028)	(1.905)	(1.999)	(3.257)	(2.239)	(0.739)
WLCV	0.32***	0.31***	0.34***	0.31***	0.31***	0.13*
	(10.687)	(4.377)	(5.280)	(8.834)	(3.621)	(1.869)
PP	0.57	-0.02	2.19	-0.35	-0.67	1.33
	(0.890)	(0.014)	(1.485)	(0.455)	(0.210)	(1.037)
PRODN	-0.933**	-0.297	-0.364	-0.813*	-1.35	0.286
	(2.258)	(0.333)	(0.390)	(1.720)	(0.803)	(0.361)
HD	0.001***	0.006	0.001*	0.002**	0.0005	0.0003
	(4.018)	(1.159)	(1.810)	(2.502)	(0.478)	(0.731)
HD2	-0.001E-4***	-0.001E-4	-9.99E-8	-0.003E-4**	-7.98E-8	-4.08E-8
	(3.149)	(0.192)	(1.437)	(2.168)	(0.510)	(1.033)
LVWT	-0.106	-0.772	0.867**	-0.453*	3.31***	1.44
	(0.661)	(1.537)	(2.483)	(1.772)	(3.501)	(1.525)
LVWT2	0.0004	0.0034	0.002*	0.002*	-0.01***	-0.006
	(0.559)	(1.478)	(1.772)	(1.882)	(3.462)	(1.501)
AUC	0.62	5.42***	-4.80***	-0.61	-2.24	3.51**
	(1.387)	(5.858)	(4.096)	(1.213)	(0.997)	(2.368)
DIR	Base	Base	Base	Base	Base	Base
COMP	2.57***	NA	3.88***	1.59***	NA	NA
	(4.28)		(2.974)	(2.718)		
TEL	-1.93*	2.68*	NA	0.83	NA	NA
	(1.764)	(1.862)		(0.284)		
POOL	0.136	3.76***	NA	-5.70***	-0.32	-4.42**
	(0.856)	(3.301)		(3.096)	(0.181)	(2.216)
EAST	-0.86	NA	NA	NA	NA	NA
	(0.193)					

NORCEN	Base	NA	NA	NA	NA	NA
SOUCEN	-0.83	NA	NA	NA	NA	NA
	(1.776)					
MOUNTAIN	1.18*	NA	NA	NA	NA	NA
	1.781					
WEST	-1.10*	NA	NA	NA	NA	NA
	(1.654)					
n	1,216	323	183	550	77	83
Adj R^2	0.716	0.615	0.755	0.862	0.850	0.821

[a]   Absolute value of calculated t statistics are in parentheses, *** = 0.01, ** = 0.05, and * = 0.10 significance levels