Determinants of Wholesale Beef-Cut Prices

Oral Capps, Jr., Donald E. Farris, Patrick J. Byrne, Jerry C. Namken, and Charles D. Lambert*

Abstract

Key determinants of monthly wholesale prices for 12 beef cuts include the quantity of the specific cut, stickiness in prices, marketing costs, quantities of pork and chicken, and seasonality. Seasonal patterns across the respective cuts are very different. Relative to the price in December, prices at the wholesale level in other months can be as much as 6 percent lower to as much as 21 percent higher.

Key Words: Wholesale prices, beef cuts, and seasonality

Background

Investigating retail demand for meat products, particularly beef, has been a preoccupation of agricultural economists for some time. During the past several years, research efforts have centered attention on structural changes in the demand for meat products at the retail level (Chalfant and Alston; Chavas; Eales and Unnevehr; Moschini and Meilke; Nyankori and Miller). While such efforts add to the store of knowledge of meat demand, this information pertains only to the retail level. Noticeably absent are studies which focus attention on demand at the wholesale level.

The demand for beef cuts at the wholesale level is of interest to beef producers and processors, especially when interest is on seasonal patterns in demand. Retailers usually absorb some of the seasonal variation in supply and demand conditions to avoid salient changes in retail meat prices. However, at the wholesale level, prices may fluctuate dramatically over short time periods.

The purpose of this paper is to examine wholesale demand for twelve beef cuts. The beef cuts correspond to ribeye (112); brisket (120); armbone chuck (126); knuckle (167); top inside round (168); bottom gooseneck (170); strip loin (180); top sirloin butt (184); full tenderloin (189); flank (193); fresh 50 percent ground beef; and fresh 90 percent ground beef. Wahl, Hayes, and Hennessy estimated compensated own and cross-price elasticities for beef cuts at the wholesale level, namely 90 percent ground beef, 50 percent ground beef, ribeye, brisket, chuck, top round, bottom round, sirloin, and tenderloin. Except for this work, estimates of elasticities or flexibilities of disaggregate beef cuts are lacking at the wholesale level. Retail level estimates of elasticities for beef cuts are available (Funk, Meilke, and Huff; Marion and Walker; Eales and Unnevehr; Wohlgenant;

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J. Agr. and Applied Econ. 26 (1), July, 1994: 183-199

Capps; Brestar and Wohlgenant). Emphasis in this analysis is on seasonal variation in beef-cut prices as well as estimates of own-quantity flexibilities for the individual beef cuts. Given the sparse prior analyses of beef demand at the wholesale level, this paper attempts to fill this void.

Model Development and Specification

At the wholesale level, prices are assumed to be endogenous because beef producers have little flexibility in altering production levels from month to month. Wholesale quantities of beef cuts must then be assumed exogenous, at least in consideration of monthly time intervals, the time series frequency used in our analysis. Demand relationships at the wholesale level are consequently represented by an inverse demand system; thus, wholesale beef-cut prices are a function of own-quantity and cross-quantities which include the quantities of other beef-cuts, pork, and chicken. These quantities are assumed to be substitutes for the individual beef-cuts. Coefficients associated with the cross-quantity variables are then hypothesized to be negative. The coefficients associated with the own-quantity terms are also hypothesized to be negative, in accordance with theory.

Since wholesale quantities are directly correlated with production quantities, seasonality in wholesale prices is hypothesized to be evident as a result of seasonal production. Consequently, the inverse demand relationships at the wholesale leve are augmented to allow for seasonality in the case of wholesale beef-cuts. No *a priori* hypotheses are given regarding the seasonal pattern of wholesale prices. However, plots of real wholesale prices over the time period in question suggest seasonal price variations do exist (Appendix A).

The wholesale sector is a link between producers and the retail sector, performing processing and services in the interim which in turn translate into marketing costs. Marketing services are not costless and so are reflected in the wholesale price. The marginal value of these marketing services can be interpreted to be equal to the marginal cost of the services (Wohlgenant and Mullen). As such, the inverse demand system for wholesale beef-cuts includes a representation of wholesale marketing costs. The coefficients associated with the marketing cost variable are hypothesized to be positive.

In a classical quantity-dependent derived demand system, inclusion of price at the next higher level is appropriate for the specification. Similarly for a price-dependent system, inclusion of quantity at the next higher level may also seem appropriate. However, retail quantities of beef-cuts are directly proportional to the wholesale quantities. Representing own-quantity at both the wholesale and retail level would give rise to perfect multicollinearity. Subsequently, retail quantity is not included in the specification since it is implicitly part of the wholesale quantity variable.

In the price-dependent or inverse demand model, lagged dependent variables are used to provide measures of price inertia associated with wholesale beef-cut prices as well as to differentiate between short-run and long-run effects. In essence, a Nerlovian partial adjustment mechanism is used. The coefficients associated with the lagged dependent variable are assumed to be not only positive but also in the unit interval.

The generic specification of the respective demand model in this study is as follows:

$P_{it} = f(QP_t, QC_t, Q_{it}, QS_{it}, P_{it-1}, IMC_t, Seasonality)$, where

P_{it} = real price of wholesale cut i (i = 1, ... 12) in month t ($/pound),

QP_t = wholesale quantity of pork per capita in month t (pounds),

QC_t = wholesale quantity of chicken per capita in month t (pounds),

Q_{it} = wholesale quantity of beef cut i per capita in month t (pounds),

QS_{it} = wholesale quantity of beef other than cut i per capita in month t (pounds),

P_{it-1} = one-period lag of real price of wholesale cut i in month t,

IMC_t= index of marketing costs in month t, and

Seasonality = monthly dummy variables to account for seasonality (base month, December).

The QS variable represents the aggregate of all wholesale cuts of beef other than the cut in question. This composite variable was used in lieu of individual cross-cut quantities to circumvent potential collinearity problems.

Data

Monthly data for the period January 1980 through December 1990 are used in the analysis. Nominal wholesale cuts of beef prices were obtained from Price Analysis Systems, USDA, AMS Central Carlot Meat Trade sheets, and personal communication with the National Cattlemen's Association. Prices were then deflated by the Consumer Price Index (1982-84=100).

A corresponding monthly data set of beef-cut quantities was derived from USDA, ERS sources (Ginzel). Total steer and heifer (labeled fed) beef per capita was proportioned as percentages of the carcass as described by Nelson et al. (USDA Agricultural Economic Report No. 623) to obtain individual wholesale primal cuts. Total steer and heifer beef consumption per capita was obtained by dividing the resident population into the sum of federally inspected steer and heifer quantities. Total non-fed beef per capita (carcass basis) was derived by adjusting commercial U.S. beef production for imports and exports, subtracting federally inspected steer and heifer beef quantities, adjusting for cold stocks, and dividing by resident population. Monthly per capita wholesale pork consumption data were obtained from USDA, ERS (Jessie) as were per capita wholesale chicken consumption figures (Weimar and Cromer).

The index of marketing costs corresponds to a simple average of the index of meat packing plant employee earnings and the producer price index of energy (U.S. Department of Labor). This index is then deflated by the CPI (1982-84=100).

Plots of the variations in wholesale quantities over the study period are exhibited in Appendix B. These plots provide evidence that wholesale beef quantities have been stationary, in a time-series sense, across cuts over the study period. Pork quantities show a notable decline on a per capita basis, and chicken quantities have been on the increase on a per capita basis over the study period.

Descriptive statistics of selected variables in the analysis are exhibited in table 1. Mean real prices for the twelve wholesale cuts range from \$0.49/pound (fresh 50 percent trimmings) to \$3.37/pound (full tenderloin). On average, the largest wholesale quantities are armbone chuck and fresh 90 percent lean beef; the lowest are for full tenderloin and flank.

Methodology

This analysis rests on the use of 132 monthly observations. The double logarithmic functional form is used for estimation. Thus, the parameter estimates correspond to flexibilities. Importantly, too, with a double-logarithmic specification, the interpretation of the coefficients associated with the seasonal dummy variables is as follows: the percentage change in wholesale price relative to the base month (December) is given by $(e^{Bi} - 1) \times 100$ percent, where B_i represents the coefficient associated with the relevant dummy variable.

Under the assumption that supply is perfectly inelastic for a given month, a seemingly unrelated regression (SUR) procedure is workable. Random and/or unavailable exogenous variates such as general level of activity, health consciousness, or concentration ratios may affect prices of the wholesale beef cuts apart from the specified predetermined variables. Consequently, the disturbance terms of the equations may be contemporaneously related. Given that the exogenous variables are not the same in each relationship, gains in estimation efficiency can be expected with the SUR procedure relative to the use of ordinary least squares (Kmenta).

Table 1. Descriptive Statistics of Selected Variables in the Model

VARIABLE	MEAN	MEDIAN	STD DEV	MIN	MAX
WHOLESALE PRICES[a]					
P112	324 08	314 75	36 62	268 00	431 60
P120	99 43	93 17	20 97	70 19	168 78
P126	101 55	94 59	19 27	73 18	158 95
P167	143.63	134 67	24 43	115 65	217 01
P168	150.88	139 84	28 66	117 14	235 21
P170	129 71	119 90	26 50	90 05	203 05
P180	268 59	256 41	46.30	185 74	406 82
P184	187 61	177 87	43.46	125.79	304 42
P189	337 27	358 67	37 21	264 40	456 42
P193	257 54	250 59	38 44	204 83	383 36
PF90	108 87	102 56	20.26	85 47	179 57
P50FL	49 31	46 71	12 26	28 33	88 11
PCHICK	49 44	48 70	6 87	34 49	68 53
PPORK	96 86	96 38	15 03	67 92	131 22
WHOLESALE QUANTITIES[b]					
Q112	0 2159	0 2269	0 0137	0 1828	0 2476
Q120	0 1738	0 1735	0 0111	0 1472	0 1994
Q126	1 5113	1 5083	0 0960	1 2801	1 7337
Q167	0 1827	0 1824	0 0116	0 1548	0 2096
Q168	0.3706	0 3699	0.0235	0 3139	0 4252
Q170	0 4623	0 4858	0 0294	0 3916	0 5304
Q180	0 2490	0 2485	0 0158	0 2109	0 2856
Q184	0 2222	0 2218	0 0141	0 1882	0 2549
Q189	0 0299	0 0298	0 0019	0 0253	0 0343
Q193	0 0286	0 0286	0 0018	0 0242	0 0328
Q90FL	2 2303	2 2487	0 3234	1 5930	3 1467
Q50L	0 8069	0 8053	0 0513	0 6835	0 9256
QPORK	5 5486	5 5500	0 4297	4 6400	6 6100
QCHICK	4 7227	4 6000	0 6755	3 3000	6 6000
QBEEF	6 4836	6 4587	0 4624	5.4105	7 6311

[a] Cents/lb (1982-84 Dollars)
[b] Pounds/per capita/month

A problem in the estimation of the system of equations is serial correlation. Due to the presence of the lagged dependent variables, disturbance terms that are autocorrelated will give rise to inconsistent parameter estimates. Additionally to detect the presence of serial correlation, the Durbin-Watson test is no longer appropriate. In this analysis, the Durbin-h test is used. Autoregressive disturbances were detected in the knuckle, strip loin, tenderloin, flank, fresh 50 percent trim, and pork equations. Serial correlation in these equations is corrected using the AUTO and DRHO options in SHAZAM.

Empirical Results

A summary of the econometric results for the model with seasonal intercept shifters is exhibited in tables 2-A and 2-B. The goodness-of-fit statistics ($\overline{R}^2$) range from .70 (flank) to .96 (chuck, gooseneck and 90 percent fresh trimmings), indicative of reasonably good explanatory power. The own-quantity flexibilities are all negative, consistent with *a priori* expectations. Except for strip loin, top sirloin, and 90 percent trimmings, all wholesale own-flexibilities are statistically different

Table 2-A. A Summary of Econometric Results for the Wholesale Price Relationships with Seasonal Intercept Shifters

WHOLE-SALE CUT	OWN CUT FLEXIBILITY (SR)	CROSS CUT FLEXIBILITY	CROSS PRODUCT FLEXIBILITY (PORK)	CROSS PRODUCT FLEXIBILITY (CHICKEN)	COEF OF ADJUST	OWN CUT FLEXI-BILITY (LR)	INDEX OF MARKETING COSTS	SEASON-ALITY[a]	ADJ R^2
112A, Ribeye	-.4707* (-3.33)[b]	-.0161 (-0.14)	.3139* (3.78)	-.0478 (-0.75)	.4261* (10.90)	-1.1047	.0006 (1.14)	6.30*	.83
120, Brisket	-.5603* (-3.94)	.1656 (1.38)	.2528* (2.94)	.0773 (1.15)	.2565* (20.74)	-2.1844	.0016* (2.63)	3.90*	.94
126, Chuck	-.3784* (-4.48)	-.0647 (-1.04)	.2463* (4.11)	-.0254 (-0.58)	.2662* (25.79)	-1.4215	.0013* (3.00)	7.54*	.96
167, Knuckle	-.2430* (-2.61)	-.1393* (-1.78)	.3357* (4.83)	-.1000* (-2.09)	.4056* (15.47)	-.5991	.0017* (3.47)	4.50*	.95
168, Top Round	-.3327* (-2.44)	-.0810 (-.74)	.4063* (4.57)	-.1412* (-2.14)	.4157* (12.96)	-.8003	.0017* (2.80)	4.56*	.92
170, Gooseneck	-.2669* (-2.82)	-.1089* (-1.67)	.2713* (3.98)	-.0584 (-1.18)	.2972* (20.00)	-.8980	.0019* (3.84)	7.09*	.96
180, Strip Loin	-.3090 (-1.60)	.1519 (0.97)	.4148* (3.32)	-.0517 (-0.55)	.4462* (9.73)	-.6925	.0011 (1.26)	7.88*	.85

[a] F - Value
[b] t - values in parentheses
* indicates significance at the 0.05 level
c cross-quantity flexibility with respect to beef

from zero. The respective short-run flexibilities range from -.0319 (fresh 90 percent) to -.9536 (fresh 50 percent trimmings). Except for brisket, strip loin, top sirloin, flank, and fresh 50 percent trimmings, the cross-quantity flexibilities are negative. However, except for knuckle and gooseneck, the cross-cut flexibilities are not statistically different from zero. Consequently, evidence of substitutability among the beef cuts is lacking. Because beef cuts arrive to wholesalers in fixed proportions to a carcass, flexibility of quantity response among cuts is apparently reduced. Therefore, at the wholesale level, cross-cut effects do not have much impact on real wholesale beef-cut prices.

Except for brisket and fresh 50 percent trimmings, the cross-product flexibilities of beef cuts with respect to chicken are negative. This evidence supports the *a priori* expectation that chicken is a substitute for beef. However, only in the cases of knuckle, top round, and flank are these cross-product flexibilities statistically significant. Values for the cross-product flexibilities of beef cuts with respect to pork are positive and significant, except for fresh 50 percent and 90 percent trimmings.

Except for brisket and fresh 50 percent trimmings, the cross-product flexibilities of beef cuts with respect to chicken are negative. This evidence supports the *a priori* expectation that chicken is a substitute for beef. However, only in the cases of knuckle, top round, and flank are these cross-product flexibilities statistically significant. Values for the cross-product flexibilities of beef cuts with respect to pork are positive and significant, except for fresh 50 percent and 90 percent trimmings.

These counter-intuitive results are consistent with other findings (Wahl, Hayes, and Hennessy; and Wohlgenant) and suggest further investigation into the relationship of pork and individual beef cuts at the wholesale level.[1]

Table 2-B. A Summary of Econometric Results for the Wholesale Price Relationships with Seasonal Intercept Shifters

WHOLE-SALE CUT	OWN CUT FLEXIBILITY (SR)	CROSS CUT FLEXIBILITY	CROSS PRODUCT FLEXIBILITY (PORK)	CROSS PRODUCT FLEXIBILITY (CHICKEN)	COEF OF ADJUST	OWN CUT FLEXI-BILITY (LR)	INDEX OF MARKETING COSTS	SEASON-ALITY[a]	ADJ R^2
184, Top Sirloin	- 1950 (-1 07)	0263 (0 18)	3337* (3 04)	- 0425* (-0 51)	3611* (10 40)	- 5400	0026* (3 17)	13 38*	93
189, Tenderloin	- 2886* (-2 15)	- 1031 (-0 92)	2770* (3 11)	- 0747 (-1 19)	2951* (14 79)	- 9780	- 0005 (-0 88)	4 23*	84
193, Flank	- 5116* (-2 17)	1488 (77)	3059* (2 13)	- 2785* (-2 48)	6046* (5 69)	- 8462	- 0001 (-0 08)	2 73*	70
Fresh 90 percent	- 0319 (-1 09)	- 1055 (-1 41)	0510 (81)	- 0383 (-0 84)	1018* (31 04)	- 3134	0001 (0 01)	2 95*	96
Fresh 50 percent	- 9536* (-4 02)	1867 (0 95)	1206 (0 75)	2095 (1 63)	3077* (15 44)	-3 0991	0030* (2 43)	2 80*	86
									Pork
Pork	- 2642* (-2 81)	2330*[c] (2 76)		- 0892 (-1 33)	5272* (7 95)	- 5011	0032* (3 76)	3.26*	94
Chicken	- 4065* (-5 25)	0544[c] (60)	2222* (2 56)		2432* (18 09)	-1 6715	- 0023* (-3 70)	6 75*	86

[a] *F* - Value
[b] *t* - values in parentheses
* indicates significance at the 0 05 level
[c] cross-quantity flexibility with respect to beef

Because of the significance of the coefficients associated with the lagged dependent variables in the model, and further because these coefficients fall in the unit interval, stickiness in wholesale prices are evident. The coefficient associated with a particular lagged dependent variable corresponds to $1-\gamma_i$, where γ_i is the coefficient of adjustment for the *i*th commodity in question (Pindyck and Rubinfeld). This coefficent relates the proportion of adjustment made toward the long-run equilibrium price in one time period (i.e., a month in this case). The coefficients of adjustment range from .1018 (fresh 90 percent) to .6046 (flank). The ratio of own-quantity flexibilities to the respective coefficients of adjustment give rise to long-run own-quantity flexibilities. As exhibited in tables 2-A and 2-B, these long-run flexibilities vary from -.3134 (fresh 90 percent) to -3.0991 (fresh 50 percent trimmings).

As expected, real marketing costs are in general positively associated with real wholesale beef-cut prices. Marketing costs are statistically significant in the brisket, chuck, knuckle, top round, gooseneck, top sirloin, and fresh 50 percent trimmings equations. For these beef cuts, a one percent change in marketing costs gives rise to a .0013 to .0030 percent change in real wholesale prices. Consequently, while marketing costs are generally statistically significant determinants of wholesale beef-cut prices, the impacts are relatively small in magnitude.

To estimate seasonal shifts in wholesale beef prices, we add a set of dummy variables, corresponding to months, to the set of predetermined variables. Arbitrarily, we chose December as the base month. Importantly, in this analysis, we only employ intercept shifters. In this measurement of seasonality, we control for the quantity of the cuts in question, the quantity of other beef cuts, the quantity of pork and chicken, marketing costs, and inertia or stickiness in wholesale beef-cut prices.

As given by the *F*-statistic in tables 2-A and 2-B, seasonality is a statistically important factor for all wholesale beef-cut prices. The percentage change in monthly wholesale price relative to December is exhibited in tables 3-A and 3-B. To illustrate, ribeye wholesale prices can vary as much as 6 percent up in July or down in January relative to December. Brisket prices can be as much as 7 percent higher in August than in December. Chuck prices may be 7 to 9 percent higher from July to September than in December. As exhibited graphically in Figures 1 - 14, the seasonal pattern varies by cut. Relative to December, ribeye prices at wholesale, *ceteris paribus*, are lower from January to April and in September and November; they are higher May to August and in October. Wholesale brisket prices are lower from March to July and in September and November relative to the price in December. However, wholesale prices of armbone chuck are higher from January to October relative to December; wholesale prices for strip loin are higher from February to October relative to December, reaching 20 percent higher in May. The key point is not only the importance of seasonality but also the variation in patterns of seasonality by wholesale beef cuts.

Concluding Remarks

This analysis adds to the rather sparse store of knowledge concerning determinants of wholesale beef-cut prices. The wholesale quantity of any beef cut is generally a key determinant of wholesale prices. The short-run flexibilities range from -.0319 to -.9536 for the specified beef cuts. However, the composite quantity of other beef cuts was not typically a significant factor affecting individual wholesale beef-cut prices, in general. This outcome is probably attributable to the fixed proportion of cuts to each carcass. Quantity of chicken was a consistently negative and significant factor in affecting the prices of the beef cuts, supporting the notion of substitution between the commodities. Marketing innovations by the poultry industry and consumer health consciousness have been major contributors to the increase in chicken consumption. On the other hand, pork displayed a positive and often significant effect on the wholesale prices, which does not support the notion of substitution. Further investigation into the relationship between beef and pork may explain why beef and pork are substitutes at the retail level but appear not to be at the wholesale level.

Stickiness or inertia is statistically significant in all wholesale beef-cut prices. Marketing costs are also key determinants of beef-cut prices at the wholesale level. Finally, seasonality is evident for all wholesale cuts. The seasonal variation in price, expressed through intercept shifters, varies from cut to cut. Relative to the price in December, beef cut prices at the wholesale level may be as much as 6 percent lower to as much as 21 percent higher.

This analysis is a useful first step in understanding wholesale beef-cut prices. Alternatively, we may seek other approaches to procuring flexibilities at the wholesale level. For example, we may estimate a matrix of elasticities for individual cuts at the retail level; simultaneously, we may estimate elasticities of price transmission for individual cuts via marketing margin analyses (Wohlgenant and Mullen). From the knowledge of elasticities of price transmission and elasticities of beef cuts at the retail level, we can obtain a matrix of flexibilities at the wholesale level.

We also may wish to expand the number of wholesale cuts. In addition, we may wish to explore the impacts of imports on wholesale beef-cut prices. Further, we may wish to investigate the potential seasonality of own-price flexibilities. Finally, similar to the work at the retail level, we may examine the issue of structural change for beef at the wholesale level, especially given increases in concentration in the livestock industry. Additional work seemingly will pay dividends to the beef industry in general and to producers and processors in particular.

Table 3-A. Percentage Change in Monthly Wholesale Price Relative to December

WHOLESALE CUT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
112A, Ribeye	-6 16* (-2 80)[a]	-3.35 (-1 47)	- 71 (-.36)	-1.82 (- 91)	4 80* (2 21)	6 44* (2 82)	5 44* (2 21)	3 82 (1 54)	-1 88 (- 85)	3 12 (1 39)	- 14 (- 07)
120, Brisket	3.29 (1 39)	1 99 (80)	-2 00 (- 92)	-1 46 (- 67)	-2 27 (- 95)	-2 86 (-1 17)	-2 03 (- 80)	7 09* (2 79)	-2 90 (-1 23)	1 09 (45)	- 35 (- 17)
126, Chuck	9.27* (5 87)	3 04 (1 82)	50 (34)	1 35 (93)	3 30* (2 08)	3 35* (2 04)	6 98* (4 06)	7 41* (4 24)	8 67* (5 47)	5 73* (3 47)	- 36 (- 26)
167, Knuckle	6.16* (4 15)	71 (41)	- 90 (- 61)	3 87* (2 58)	5 66* (3 35)	3 66* (2 04)	2 19 (1 15)	4 90* (2 71)	4 18* (2 56)	2 63 (1 64)	-1 74 (-1 35)
168, Top Round	2 66 (1 14)	.16 (07)	2 61 (1 25)	8 27* (4 85)	11 27* (4 52)	5 52* (2 05)	4 79 (1 75)	7 66* (2 86)	2 91 (1 22)	2 84 (1 18)	-2 81 (-1 35)
170, Gooseneck	5 64* (3 19)	19 (10)	-1 84 (-1 15)	21 (13)	08 (04)	-3 11 (-1 71)	05 (03)	5 05* (2 69)	7 01* (4 06)	4 39* (2 43)	41 (26)
180, Strip Loin	- 94 (- 33)	9 46* (3.01)	6 35* (2 30)	13 21* (4 57)	20 78* (6 14)	17 08* (4 46)	12 65* (3 08)	10 35* (2 65)	3 71 (1 08)	93 (29)	-1 55 (- 61)

* indicates significance at the 05 level
[a] (*t*-statistic of corresponding regression coefficient)

Table 3-B. Percentage Change in Monthly Wholesale Price Relative to December

WHOLESALE CUT	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
184, Top Sirloin	6 23* (2 20)	13 13* (4 32)	7 25* (2 59)	16 25* (5 59)	21 49* (6 01)	15 12* (3 65)	11 93* (2 77)	10 30* (2 50)	06 (02)	70 (22)	-3 91 (-1 54)
189, Tenderloin	-1 43 (- 72)	-6 08* (-2 84)	32 (17)	35 (18)	5 15* (2.41)	3 96 (1 73)	1 90 (76)	- 63 (- 26)	-3 10 (-1 46)	- 20 (- 09)	1 07 (61)
193, Flank	4 43 (1 29)	2.13 (56)	7 20* (2 17)	10 31* (3 01)	14 85* (3 86)	5 47 (1 35)	31 (07)	4 74 (1 18)	3 59 (98)	4 29 (1 16)	1 20 (38)
Fresh 90 percent	1 34 (85)	3 14 (1 90)	- 28 (- 19)	-2 72 (-1 81)	-1 27 (- 76)	-.82 (- 48)	1 01 (55)	1 47 (80)	-1 62 (- 98)	-2 00 (-1 22)	-2 75* (-1 98)
Fresh 50 percent	2 12 (54)	7 45 (1.70)	3 55 (93)	8 54* (2 18)	10 36* (2 43)	7 02 (1 59)	12 02* (2.57)	16 65* (3 57)	2 17 (51)	2 16 (50)	5 33 (1 52)
Pork	-6 47* (-3 99)	-5 65* (-2.85)	-4 61* (-2 53)	-5 36 (-2 71)	-2 07 (- 96)	-1 28 (- 57)	-1 64 (- 70)	-1 20 (- 54)	-4 22* (-2 11)	-3 49 (-1 88)	-3 52* (-2 56)
Chicken	10 64* (4.32)	5.55* (2 13)	6 07* (2 67)	3 67 (1.58)	13 80* (5 77)	10 60* (4 16)	13 51* (5 15)	8 26* (3 05)	6 25* (2 53)	29 (11)	1 86 (82)

* indicates significance at the 05 level
(*t*-statistic of corresponding regression coefficient)

Figure 1. Percentage Change in Monthly Wholesale Price Relative to December for Ribeye

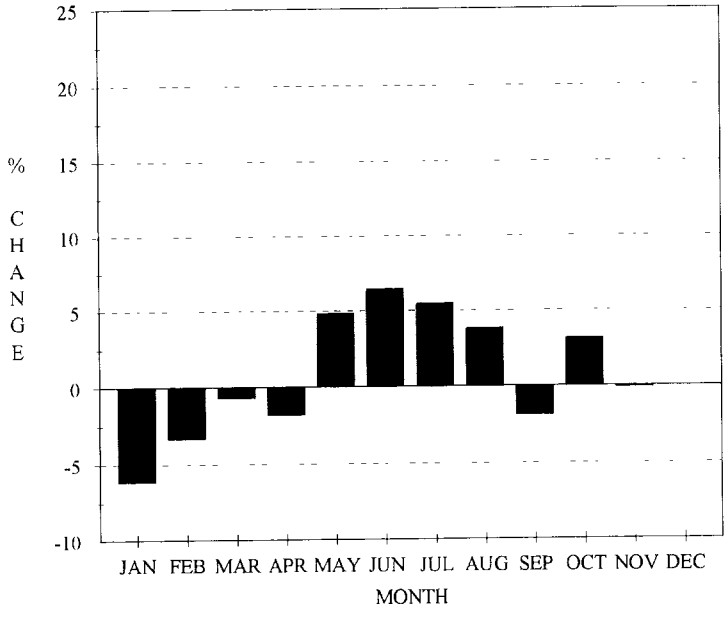


Figure 2. Percentage Change in Monthly Wholesale Price Relative to December for Brisket

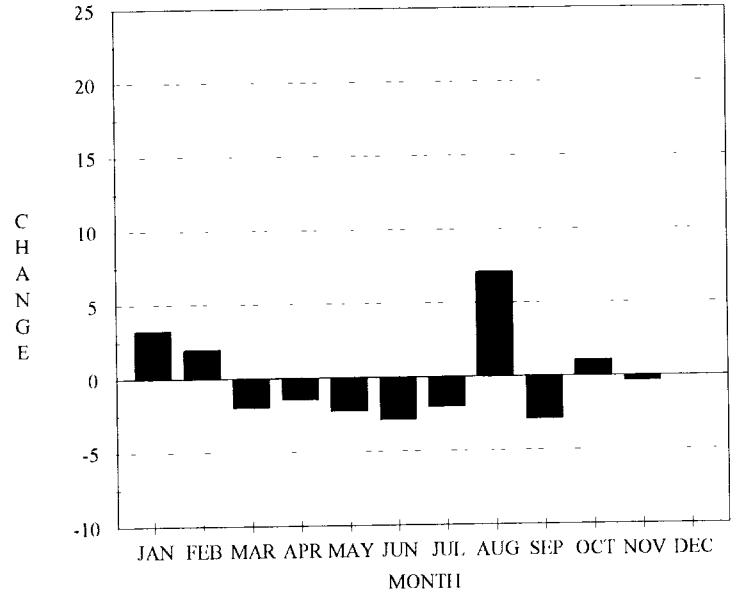


Figure 3. Percentage Change in Monthly Wholesale Price Relative to December for Chuck

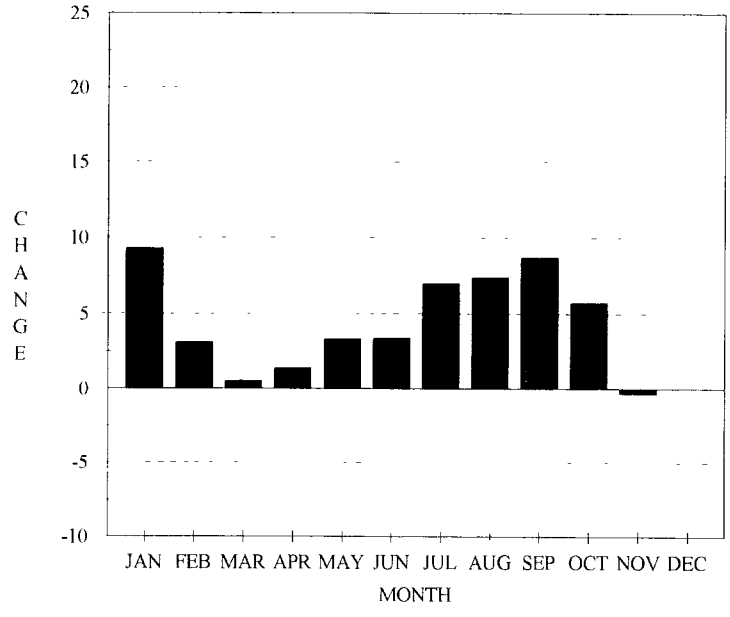


Figure 4. Percentage Change in Monthly Wholesale Price Relative to December for Knuckle

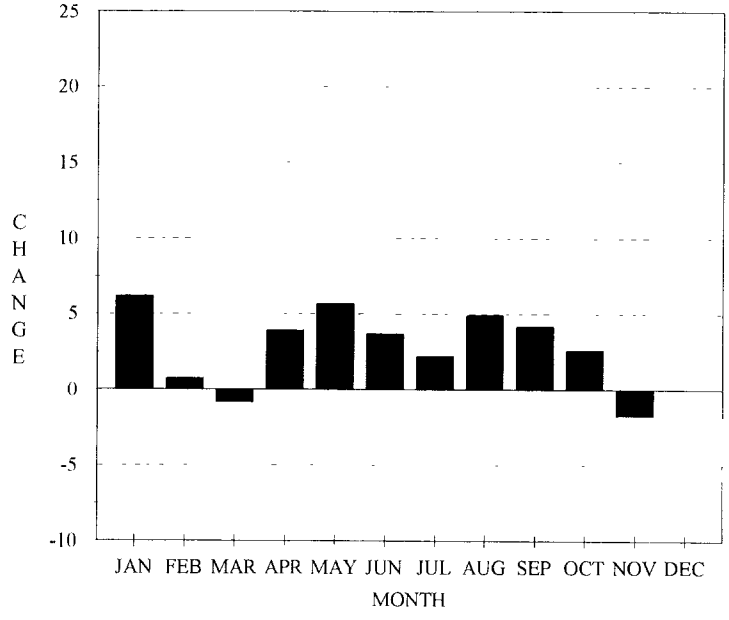


Figure 5. Percentage Change in Monthly Wholesale Price Relative to December for Top Round

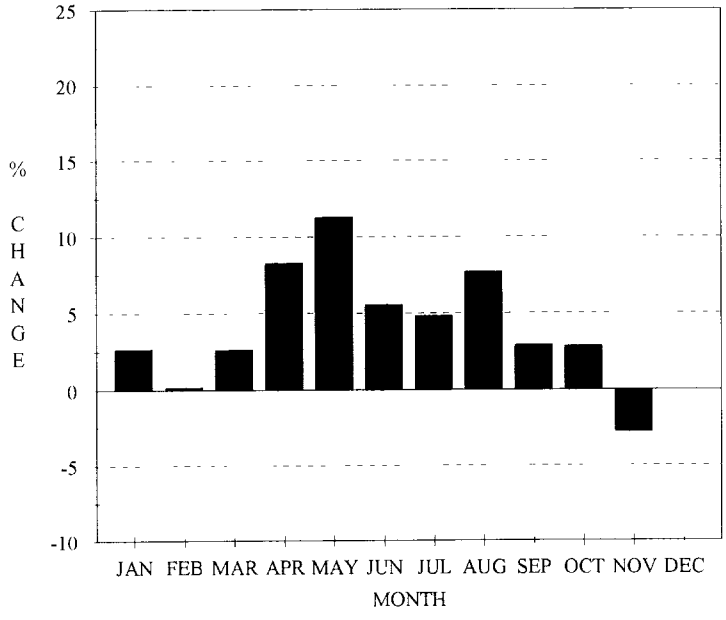


Figure 6. Percentage Change in Monthly Wholesale Price Relative to December for Gooseneck

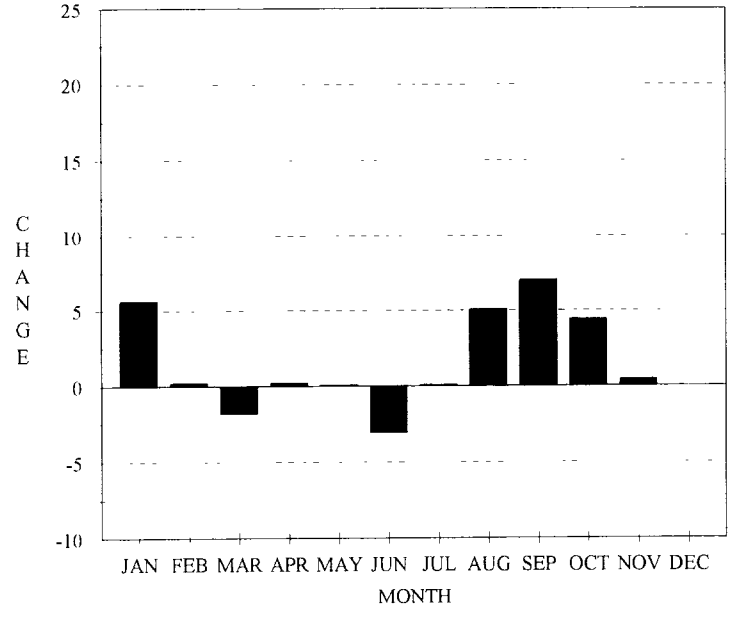


Figure 7. Percentage Change in Monthly Wholesale Price Relative to December for Strip Loin

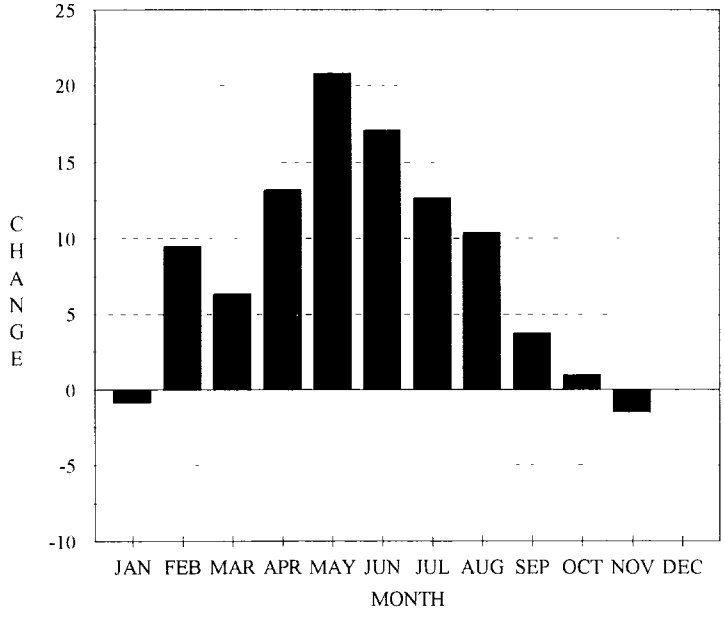


Figure 8. Percentage Change in Monthly Wholesale Price Relative to December for Top Sirloin

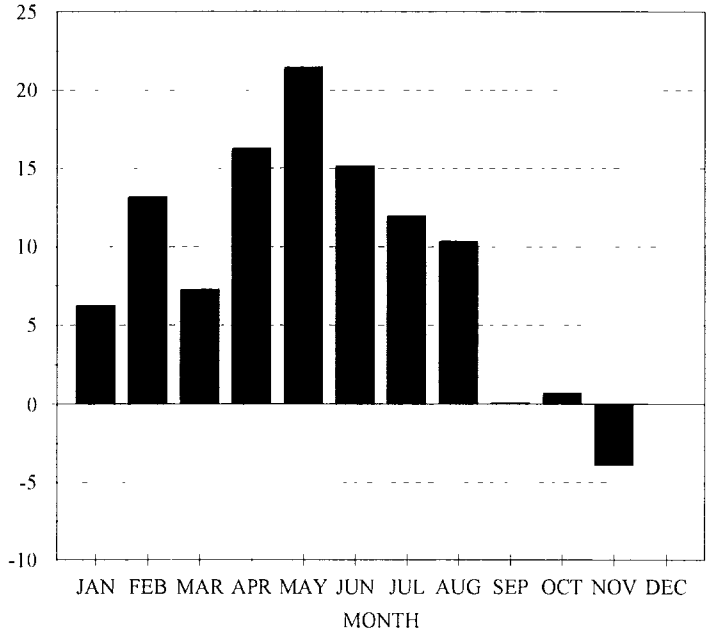


Figure 9. Percentage Change in Monthly Wholesale Price Relative to December for Tenderloin

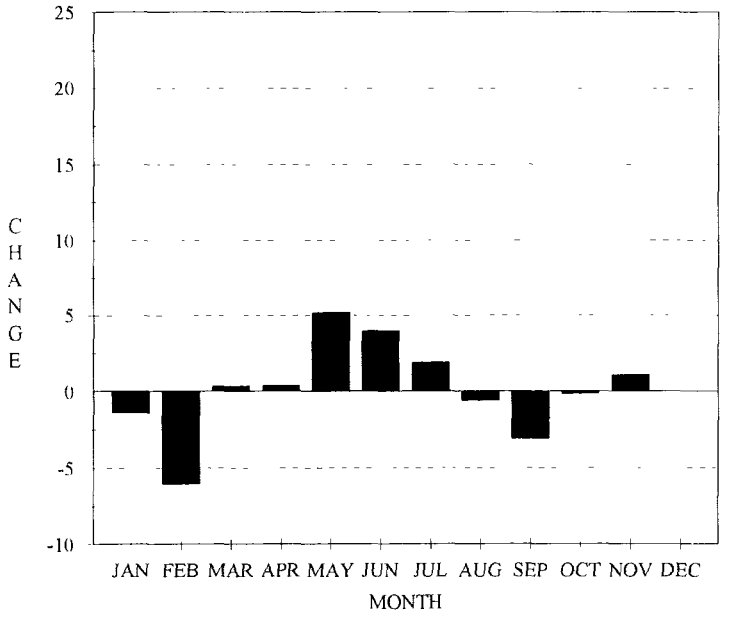


Figure 10. Percentage Change in Monthly Wholesale Price Relative to December for Flank

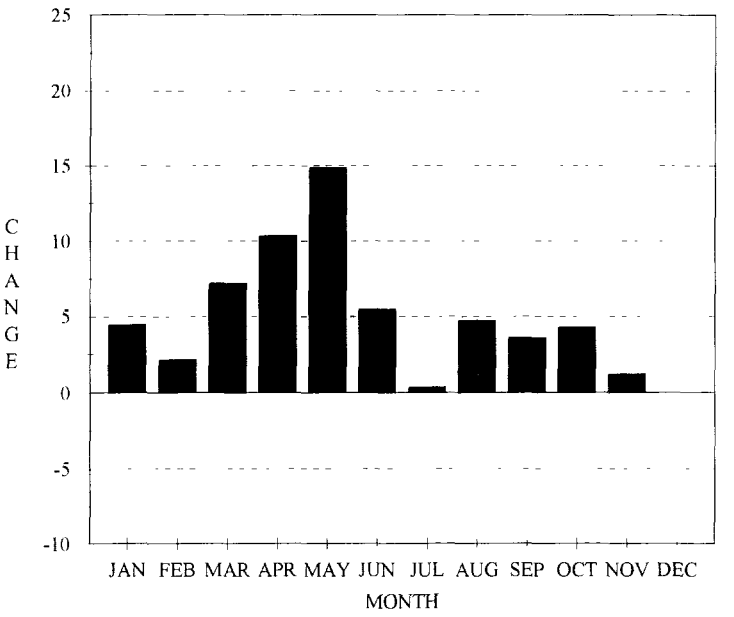


Figure 11. Percentage Change in Monthly Wholesale Price Relative to December for Fresh 90%

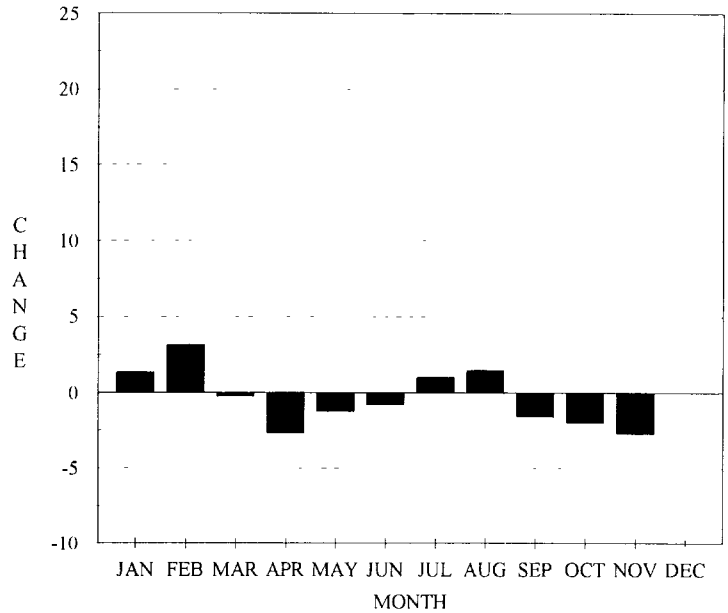


Figure 12. Percentage Change in Monthly Wholesale Price Relative to December for Fresh 50%

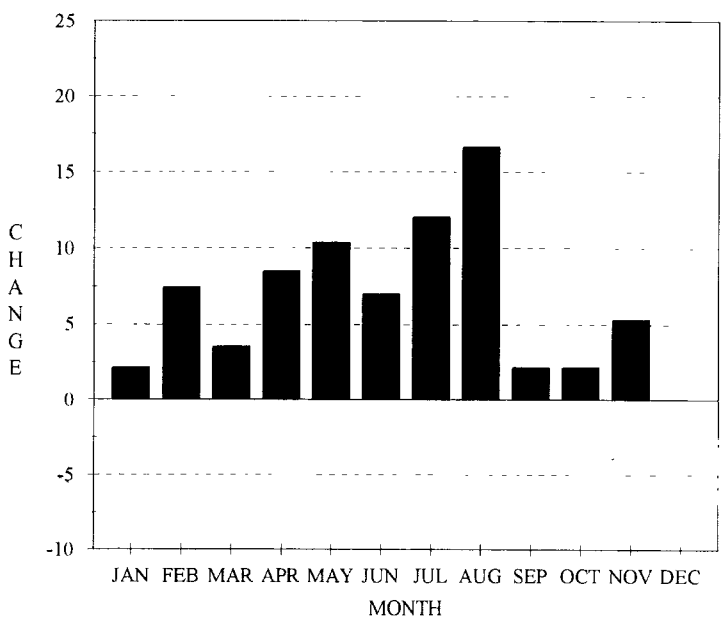


Figure 13. Percentage Change in Monthly Wholesale Price Relative to December for Pork

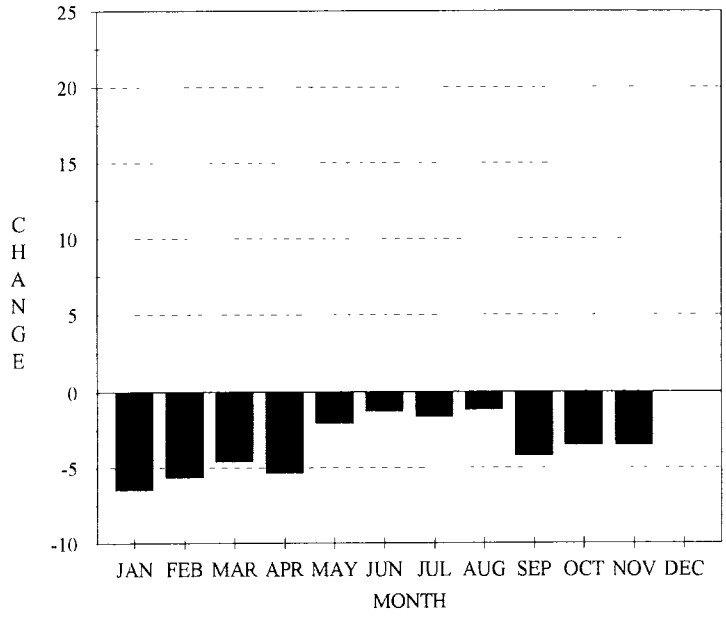
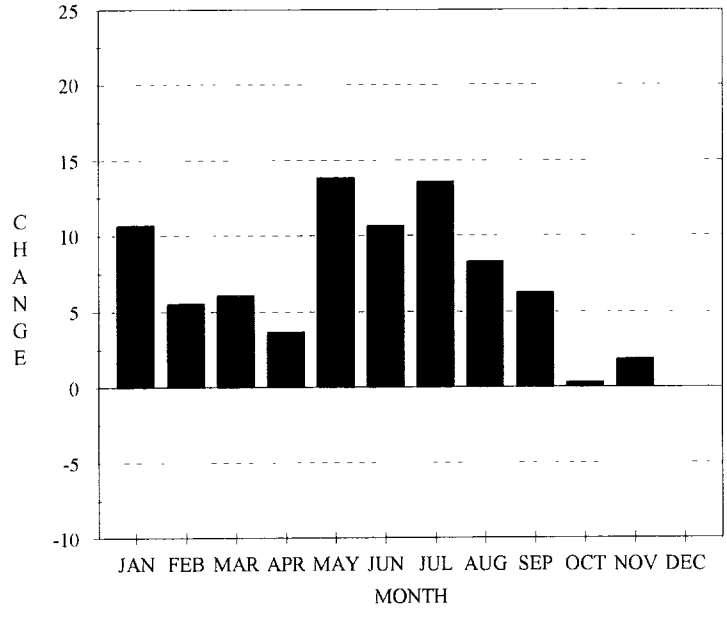


Figure 14. Percentage Change in Monthly Wholesale Price Relative to December for Chicken



References

Brester, G.W. and M.K. Wohlgenant. "Estimating Interrelated Demands for Meats Using New Measures for Ground and Table Cut Beef." *Amer. J. Agr. Econ.* 72(1991):1182:1194.

Capps, O., Jr. "Utilizing Scanner Data to Estimate Retail Demand Functions for Meat Products." *Amer. J. Agr. Econ.* 71(1989):750-60.

Chalfant, J. and J. Alston. "Accounting for Changes in Tastes." *J. Polit. Econ.* 96(1988):331-40.

Chavas, J.P. "Structural Change in the Demand for Meat." *Amer. J. Agr. Econ.* 5(1983):148-53.

Eales, J.S. and L.J. Unnevehr. "Demand for Beef and Chicken Products: Separability and Structural Change." *Amer. J. Agr. Econ.* 70(1988):521-32.

Funk, T.F., K.D. Meilke, H.B. Huff. "Effects of Retail Pricing and Advertising on Fresh Beef Sales." *Amer. J. Agr. Econ.* 9(1977):533-37.

Ginzel, J. USDA, ERS data set by personal correspondence.

Jessie, W.B. USDA, ERS data set by personal correspondence, 1991.

Kmenta, J., *Elements of Econometrics*, Second Edition. Macmillan Publishing: New York (1986).

Marion, B.W. and F.E. Walker. "Short-Run Predictive Models for Meat Sales." *Amer. J. Agr. Econ.* 60(1978):667-73.

Moschini, G. and K.D. Meilke. "Structural Change in U.S. Meat Demand: Further Evidence." Proceedings of NCR Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. St. Louis, MO, 1988.

Nelson, K.E., L.A. Duewer, and T.L. Crawford. "Reevaluation of the Beef Carcass-to-Retail Weight Conversion Factor." Commodity Economics Division, Economic Research Service, USDA Agricultural Economic Report No. 623. 1989. p. 28.

Nyankori, J.C.O. and G.H. Miller. "Some Evidence and Implications of Structural Change in Retail Demand for Meats." *S. J. Agr. Econ.* 14(1982):65-70.

Pindyck, R.S. and D.L. Rubinfeld, *Econometric Models and Forecasts*, Third Edition. McGraw-Hill, Inc.: New York (1991).

Price Analysis Systems. "Meat Price Relationships." Memphis, TN 1990 Edition.

---- "Meat Price Relationships." Memphis, TN 1991 Edition.

Sands, M. Data set by personal correspondence.

USDA, Agricultural Marketing Service. "Wholesale Meat Quotation. Central U.S. Carlot Meat Trade." Des Moines, IA.

USDA, Economic Research Service. "Livestock and Meat Statistics, 1984-88." Table 140. Washington, DC.

United States Department of Labor, "Employment and Earnings of the United States." Washington, DC. various issues.

Wahl, T.I., D.J. Hayes, and D. Hennessy. "Analyzing the Seasonality of U.S. Meat Demand Using Disaggregated Weekly Data." Unpublished paper. 1990.

Weimar, M.R. and S. Cromer. "Egg and Poultry Statistical Series, 1960 - 89". USDA, Economic Research Service. Statistical Bulletin No. 816. Washington, DC. September, 1990.

Wohlgenent, M.K. "Effects of the Changing Composition of Beef Consumption in the Elasticities for Beef and Poultry." In the *Economics of Meat Demand,* R.C. Buse, Editor, Proceedings of the Conference on the Economics of Meat Demand.

Wohlgenent, M.K. and J.D. Mullen, "Modeling the Farm - Retail Price Spread for Beef", *W. J. Agr. Econ.* 12,2 (1987):119-125

Wonnacott, R.J. and T.H. Wonnacott, *Econometrics*, Second Edition. John Wiley and Sons: New York (1979).

Endnotes

1.As set forth by Belsey, Kuh, and Welsh, multicollinearity diagnostics suggested potentially degrading problems between the pork quantity variable, the lagged price variable and the own-quantity variables for some of the cuts. Possible degrading collinearity was also diagnosed between the chicken quantity and marketing costs variables. Aggregation of the pork and chicken quantity variables did not alleviate the collinearity problem, and it did not yield the expected sign for the estimated coefficients. Correlation analyses between the dependent variables and the pork quantity variables indicated positive correlation in all cases, usually of the magnitude ranging from .35 to .45. As a result, the model specification was not altered for this analysis. Further investigation into the relationship between wholesale beef-cut prices and the quantity of pork is certainly warranted.