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# The Demand for Wholesale Beef Cuts by Season and Trend

Jerry C. Namken, Donald E. Farris and Oral Capps, Jr.

This study estimates demand during the 1980-90 period for wholesale beef cuts by season and by trend. A data set containing monthly nominal prices for wholesale cuts and average choice boxed beef from January 1980 to December 1990 was collected from multiple sources. The approach expressed the change in demand for wholesale cuts as the change in the price ratio of individual cuts relative to the price of boxed beef. This approach shows changes in amount by season and over time relative to the average wholesale cut. Brisket, Armbone Chuck, Bottom Gooseneck, and Knuckle showed the strongest demand in winter and lowest in summer. Top (Inside) Round had a clear downward trend in demand, but the seasonal pattern was less pronounced and more erratic than the lower-priced cuts. Top Sirloin Butt had its highest demand in spring and summer with November-December being the lowest period. Strip Loin had the strongest warm season demand during the period which contains Memorial Day. Ribeye experienced a seasonal demand highest in November-December and lowest in January to April. Full Tenderloin was the most expensive wholesale beef cut analyzed in the study, and its demand was highest in November-December. The study clearly showed that a change in seasonal demand was responsible for the major part of price ratio fluctuations for individual wholesale cuts.

## Introduction

The general trend in the U.S. per capita red meat supply for the 1980-90 period has been declining while the trend in the per capita supply of poultry has increased. The most dramatic change is a 29.3 pounds per capita increase in poultry, while beef supply declined 8.8 pounds. Pork declined most in the early 1980s, but for the 11 year period declined 7.5 pounds (Figure 1).

These changes apparently have been driven by structural changes in demand. Causes of changes in demand are generally understood but are not easy to document, especially if the change in demand for different segments of each of the red meat and poultry industries is considered. There is a general indication that the growth in demand is for those cuts of meat, poultry, and fish products with higher quality, more convenience, and less fat.

Within these general trends, there is considerable variation in demand and supplies by season. During the 1980-90 period changes in beef supplies were

mostly seasonal with a decline in total beef occurring the last four years of the period. Most of this decline was due to a decline in cow slaughter which resulted in a drop in non-fed beef supplies. Most of the fluctuation in the steer and heifer beef supply was seasonal (Figure 2).

## Objectives

The objective of this study is to estimate changes in demand for different types of wholesale beef cuts as influenced by quality, convenience, and season during the 1980-90 period. Specific objectives are:

1. Refine the estimates of trend and season in demand using bimonthly and monthly periods for specific wholesale cuts relative to average USDA choice boxed beef.
2. Compare alternative estimating models.
3. Elaborate the rationale for using price ratios of individual wholesale cuts to average boxed beef (carcass composite) to avoid problems common to using deflated price time series.

## Previous Research

Most of the meat demand studies have dealt with average retail price data for the commodities of beef, pork, and chicken (Funk, Meilke and Huff 1977,

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Agricultural economist, USDA, RDA, Cooperative Services; Professor, Department of Agricultural Economics, Texas A&M University; Professor, Department of Agricultural Economics, Texas A&M University.

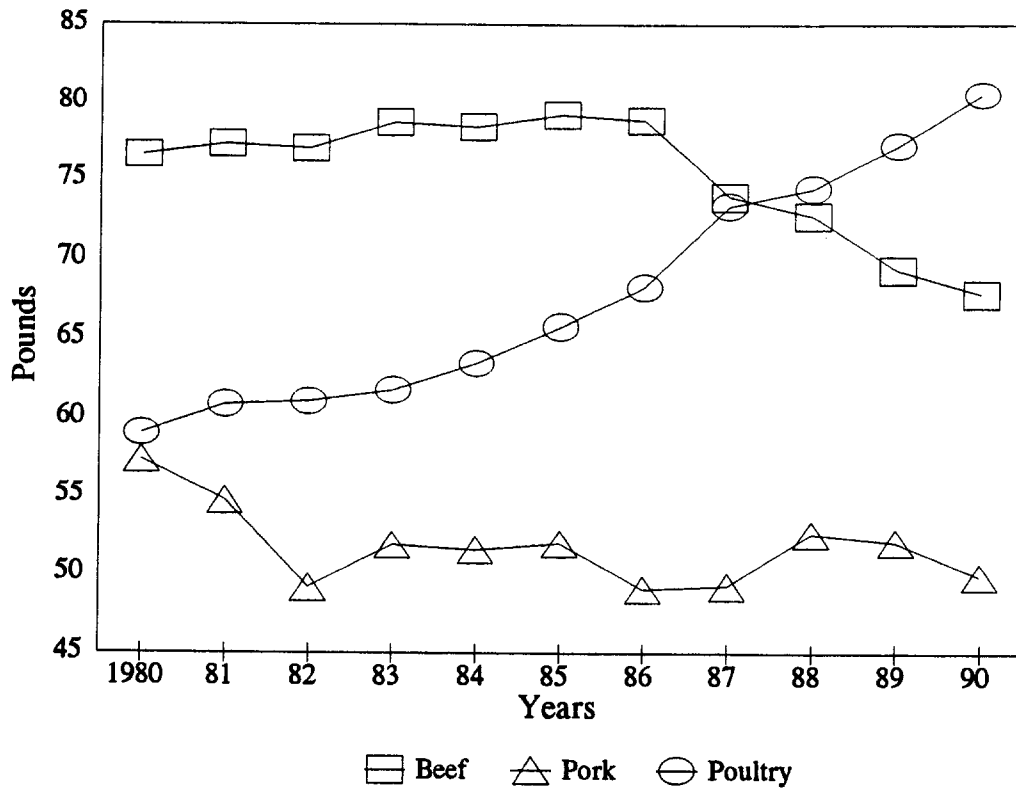


Figure 1. Per Capita Disappearance of Beef, Pork, and Poultry From 1980 - 90 (Retail Weight Basis - Pounds). Source: U.S. Department of Agriculture.

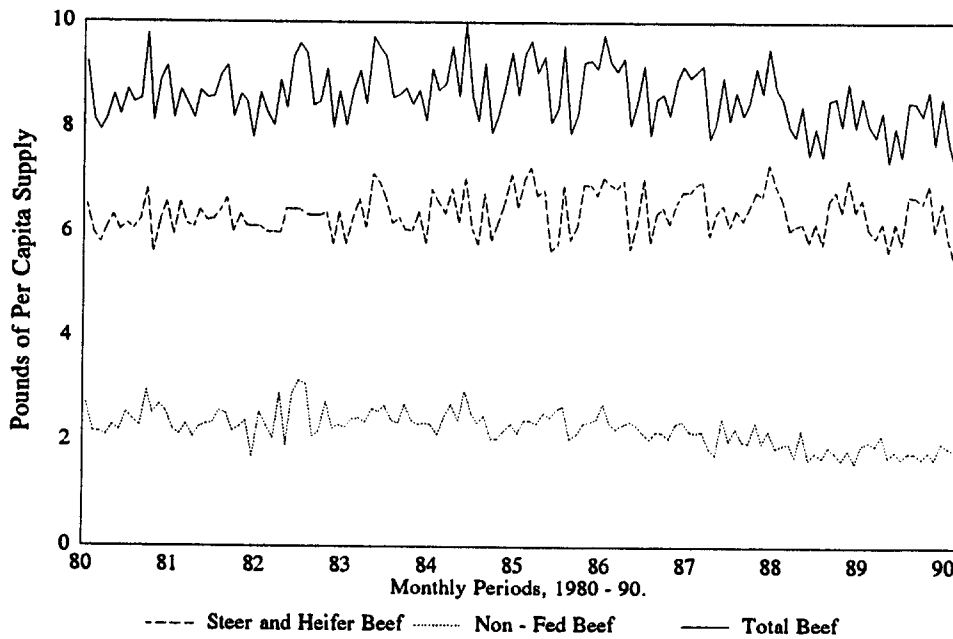


Figure 2. Comparison of Per Capita Supply of U.S. Beef (Carcass Weight).

Marion and Walker 1978, Capps 1989). Few existing studies disaggregated beef demand into demand for individual wholesale cuts.

Procopio used a weekly price index to examine seasonal differences in three wholesale cuts of meat for the period 1985-89. The cookout season resulted in a Memorial Day period price peak of 18 percent above the annual average for boneless strip loins, and a peak of 16 percent for pork spareribs. Boneless arm chuck, which produces mostly roasts, and ground beef, had highest prices during the winter months.

Capps et al. used multivariate analyses to develop flexibilities related to wholesale beef cuts. Where price, lagged one month, was used as an independent variable, short-run own flexibilities varied from -.0319 for non-fed beef (meaning that it is very price sensitive to changes in supply) to 50 percent Lean Trimmings at -.9536 (the least sensitive to supply changes). Fifty percent Lean Trimmings was followed by other lower priced cuts in order of value (Brisket, -.56, Chuck, -.38). Most of the higher valued cuts were just under -1.0 with Tenderloin, the most expensive cut, at -.29. Pork and chicken had lower own flexibilities at -.26 and -.41 respectively. Few of the cuts had significant beef-cut cross flexibilities, indicating their prices were more sensitive to their own supplies.

After explaining the theoretic basis for the ratio approach, Farris and Holloway (1990) showed that a change in the ratio of the price of a wholesale cut to the average wholesale price of the carcass composite was evidence of a trend in the demand for that cut relative to all fed beef. They provided estimates of different seasonal effects of wholesale and retail cuts relative to all fed beef. Using USDA, AMS data from 1980 through 1989, they estimated trend and seasonal coefficients (three month averages, i.e., December, January, and February prices were averaged to represent winter) for 12 wholesale cuts, including 50 percent and 85 percent Lean Trimmings. Adjusted R<sup>2</sup> values ranged from .20 to .90 with Durbin-Watson (DW) values ranging from .61 and 2.33, however most DW values were close to 1.0. This provided unbiased parameter estimates, but standard errors were not reliable.

## Methodology

This analysis used the same basic approach as Farris and Holloway (1990) except monthly and bimonthly seasonal effects were measured instead of 3 month seasonal estimates. In addition, the dependent price ratio was lagged and used as an independent variable for a comparison.

A monthly price ratio of 12 individual wholesale cuts to the Boxed Beef carcass composite provided the

dependant variables for the general model. Independent variables were relative demand, time trend, and bimonthly seasonal effects in the first model. In the second model, the price ratio variable was lagged one month and added as an independent variable to reduce unexplained error. The third model differed with the seasonal variables changed from bimonthly to monthly.

The rationale for using a price ratio dependant variable is that the nominal price of USDA choice boxed beef embodies the demand and supply influence of the current beef market and the influence of substitutes. The nominal price of the individual wholesale cut is influenced by the level of boxed beef and the difference in the demand for the individual cut from the average cut. The monthly price ratio then represents the change in the price of an individual cut relative to the average choice beef cut. Since quantity of the cut is a fixed proportion of the quantity of boxed beef, the change in the price ratio represents a change in the relative demand of the individual cut.

The trend in demand for the individual cut relative to Boxed Beef average is measured by a trend variable where January 1980 is 1.0, February 1980 is 1.1 and December 1990 is 14.1. The demand difference from Boxed Beef due to monthly and bimonthly periods is expressed by dummy variables as deviations from a base period.

The hypotheses are:

1. The trend in demand for higher valued cuts is increasing during the 1980 to 1990 period.
2. The demand for wholesale cuts that are used more for steak when outside grilling is greater during warm weather than cold weather; whereas, the demand for wholesale cuts that produce mostly roasts is greater during the cold months.

The specifications for the first model are:

$$PR_{it} = \alpha + \beta_1 T_{it} + \beta_2 \text{Jan-Feb}_i + \beta_3 \text{Mar-Apr}_i + \beta_4 \text{May-Jun}_i + \beta_5 \text{Jul-Aug}_i + \beta_6 \text{Sep-Oct}_i + \beta_7 \text{Nov-Dec}_i$$

where bimonthly periods are dummy variables expressed as deviations from Nov-Dec<sub>i</sub>, and where PR<sub>it</sub> = Price Ratio of Cut<sub>it</sub> = (nominal price of cut<sub>it</sub>/Boxed Beef Price<sub>i</sub>).

The second model includes lagged price ratio as an independent variable and becomes:

$$PR_{it} = \alpha + \beta_1 PR_{it-1} + \beta_2 T_{it} + \beta_3 \text{Jan-Feb}_i + \dots + \beta_8 \text{Nov-Dec}_i$$

where bimonthly periods are dummy variable expressed as deviations from Nov-Dec<sub>i</sub>.

The third model is expressed by:

$$PR_{it} = \alpha + \beta_1 PR_{it-1} + \beta_2 T_{it} + \beta_3 Jan_i + \beta_4 Feb_i + \dots + \beta_{14} Dec_i$$

and where  $PR_{it-1}$  = Price Ratio of  $Cut_{it}$  = (nominal price of  $cut_{it}$ /Boxed Beef Price)

$PR_{it-1}$  = lagged Price Ratio of  $cut_i$

$T_i$  = monthly or bimonthly period where  $T_1$  = January 1980 = 1.0 and  $T_2$  = February 1980 = 1.1 ...  $T_{120}$  = December 1990 = 14.1

$Jan_i \dots Dec_i$  = monthly dummy variables

$Jan-Feb_i \dots Nov-Dec_i$  = bimonthly dummy variables.

### Wholesale Price Data

A data set containing nominal prices for wholesale cuts of beef from January 1980 to December 1990 was collected from multiple sources. Prices for all cuts from January 1980 to December 1981 and for Full Tenderloin, and Flank Steak from January 1982 through December 1990 were obtained from Price Analysis Systems (1990, 1991). Price information for Ribeye, Brisket, Armbone Chuck, Knuckle, Top Inside Round, Bottom Gooseneck, Strip Loin, and Top Sirloin Butt from January 1982 through December 1990 were taken from USDA, AMS Central Carlot Meat Trade sheets. Prices for 50% Lean Trimmings, 90% Lean Trimmings, and Boxed Beef Cut-out were obtained from Mike Sands (1980-89). 1990 prices for these three items were obtained from Carlot Meat Trade sheets.

Wholesale quantity data were not directly used in this study except to show monthly per capita production of beef (Figure 2). This approach assumes that total U.S. beef supply and demand is embodied in the average monthly price of wholesale boxed beef. Since individual wholesale cuts are produced in a relatively constant proportion to wholesale boxed beef, this ratio (price of wholesale cuts to the price of wholesale boxed beef) is expected to reflect the demand for wholesale cut  $i$  for time period  $t$  relative to average box beef at the same time and place.

The detailed results from this monthly wholesale model are in Appendix Table 1. This table provides estimates of monthly shifts in demand and trends in demand with acceptable statistical measures for most cuts. The monthly detail requires more study to understand this table, however. To improve stability, clarity, and ease of presentation, the dummy variables were converted to bimonthly periods by combining January-February, March-April ... November-December. These estimates are deviations from the

November-December average. This model was estimated with and without the Price Ratio lagged one period. Most of the following discussion is of the model results with lagged Price Ratio omitted.

### Results

The demand for individual wholesale cuts of beef varies mostly by season; however, there has been dramatic trends in demand for all beef as well as unique trends for specific beef cuts. The general trend in steer and heifer beef supplies was remarkably stable during the 11 year period of 1980 through 1990. The primary variation in per capita supplies of beef have been seasonal (Figure 2).

Both fed beef and non-fed beef experience erratic short-term changes in supplies. Generally, monthly supplies varied in a range of 95 percent to 105 percent of the 1980-90 average. Supplies averaged lowest in March and highest in October (Figure 3). These months were adjusted for a constant number of days per month (30.4) (otherwise February, with three fewer days than March, would show the lowest monthly supply).

Although annual per capita supply changed very little during the 1980-90 period, short term supply changes of ten percent, plus seasonal demand changes, resulted in considerable short-term price variability in wholesale cuts of beef. Despite these rather stable annual supplies during the 1980s, the real (deflated) price trend declined rather sharply from 1980 to 1986 (Figure 4).

### Demand by Season and Trend

Beginning with the lowest priced wholesale cuts, seasonal demand patterns and trends are illustrated in Figure 5. Packer-style Brisket showed the strongest demand in winter and lowest in summer. In the early 1980s, it was priced above the average for wholesale choice boxed beef, but by the last half of the 1980s its price averaged below that level (indicated by a price ratio below 1.0). The sharp increase in demand for Brisket in winter apparently depended on demand for corned beef, as well as roasts in winter.

Summer demand is supported by outdoor smoking and grilling, especially in the Southwest. Packer style brisket is often sold by food retailers in the Southwest as a "loss-leader." The trend in demand over time for Brisket (as was the case for most of the lower priced cuts) was clearly downward relative to all fed beef (Figure 5). The statistical results of these analyses are presented in Table 1. Despite the mediocre statistical measurement, these graphics show a remarkably good fit between the observed and pre-

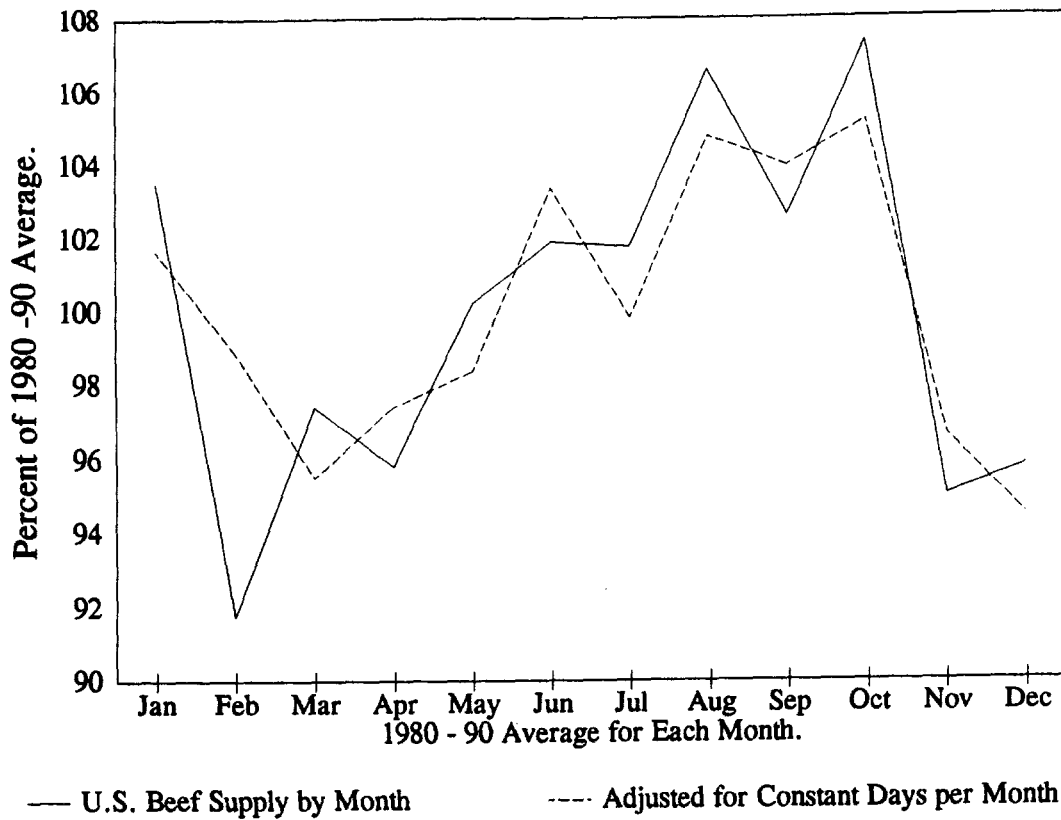


Figure 3. U.S. Beef Supply by Months and by Constant Days per Month, as a Percent of 1980 - 90 Average.

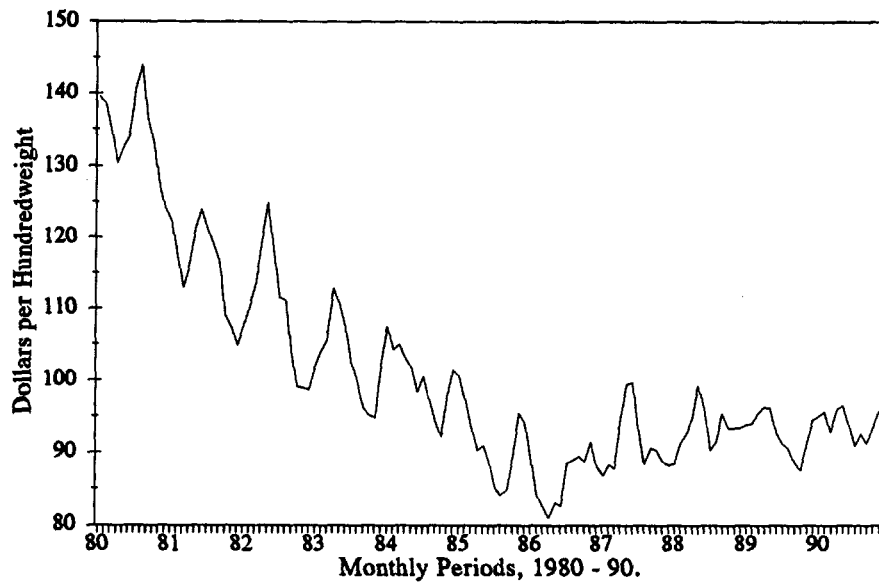


Figure 4. Monthly Price for Boxed Beef Cut-Out, 1980 - 90, Deflated by CPI, 1982 - 84 = 100.

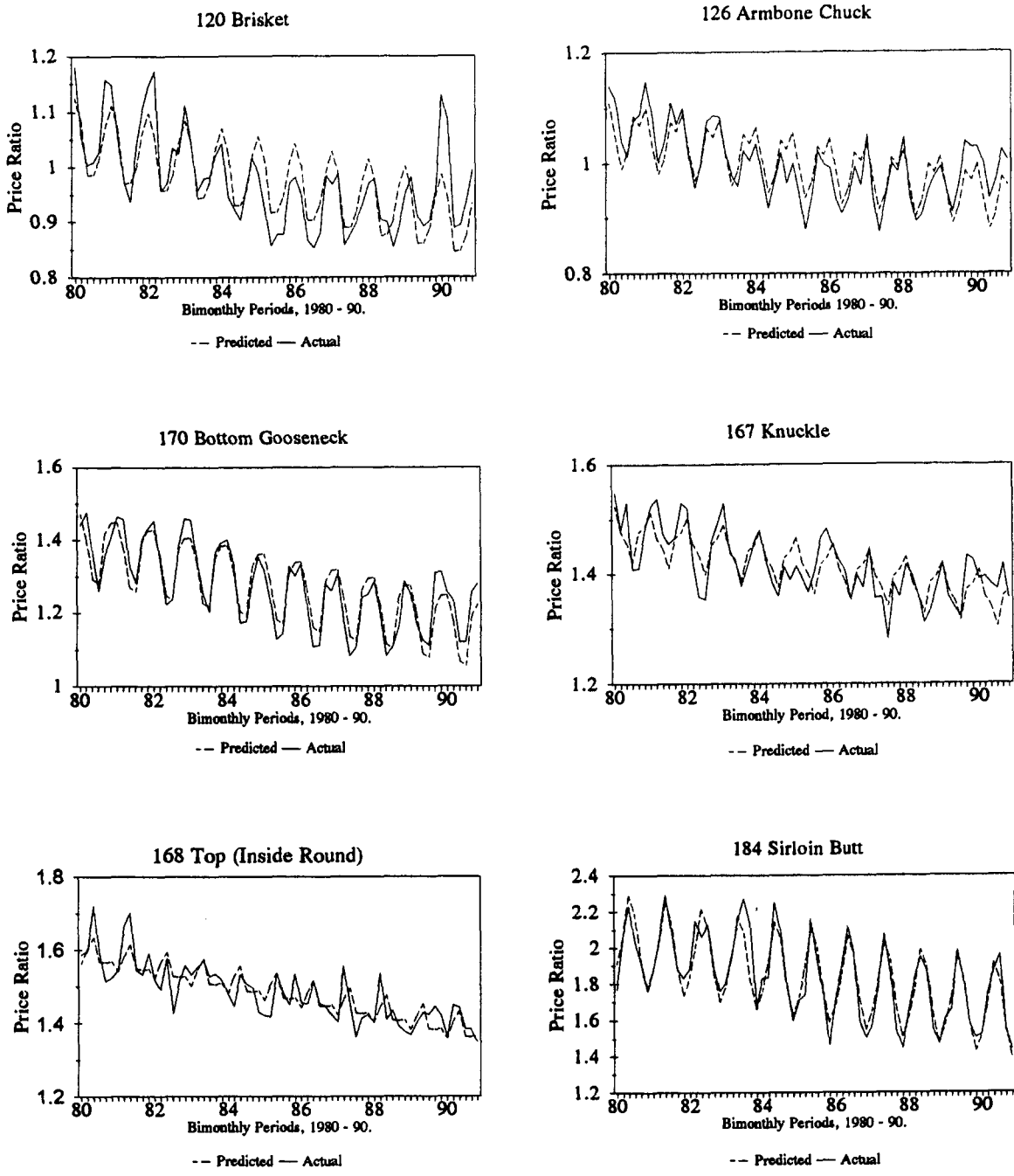


Figure 5. Seasonal Demand and Demand Trend Relative to Boxed Beef Cut-Out For Selected Cuts of Wholesale Beef, 1980 - 90.

**Table 1**  
Price ratio of wholesale beef cuts, trend/bimonthly model, 1980-90

ITEM	MEAN RATIO <sup>a</sup>	INTER-CEPT	TREND	JAN-FEB <sup>b</sup>	MAR-APR <sup>b</sup>	MAY-JUN <sup>b</sup>	JUL-AUG <sup>b</sup>	SEP-OCT <sup>b</sup>	ADJ R <sup>2</sup>	DW
FRESH 50%, TRIMMINGS	.48	.5288 (29.42) <sup>c</sup>	-.0069 (-4.69)	-.0164 (-.85)	.0022 (.12)	.0082 (.42)	.0382 (1.98)	.0014 (.071)	.16	.46
120, BRISKET	.98	1.0977 (68.10)	-.0115 (-8.74)	.0390 (2.26)	-.00007 (-.004)	-.0959 (-5.56)	-.0932 (-5.41)	-.0627 (-3.64)	.58	.89
126, ARMBONE CHUCK	1.00	1.0871 (100.00)	-.0091 (-10.33)	.0327 (2.80)	-.0273 (-2.34)	-.0832 (-7.15)	-.0523 (-4.50)	.0150 (1.29)	.65	.58
FRESH 90% TRIMMINGS	1.07	1.0712 (51.18)	-.0033 (-1.95)	.0581 (2.59)	.0592 (2.64)	-.0038 (-.17)	.0278 (1.24)	.0216 (.97)	.09	.46
170, BOTTOM GOOSENECK	1.27	1.4858 (107.17)	-.0183 (-16.26)	.0053 (.36)	-.0642 (-4.32)	-.1678 (-11.31)	-.1751 (-11.81)	-.0350 (-2.36)	.81	1.04
167, KNUCKLE	1.41	1.5069 (131.17)	-.0097 (-10.41)	.0285 (2.31)	-.0173 (-1.41)	-.0363 (-2.95)	-.0693 (-5.64)	-.0124 (-1.01)	.58	.88
168, TOP (INSIDE) ROUND	1.48	1.6022 (101.32)	-.0166 (-12.90)	-.0229 (-1.35)	.0240 (1.47)	.0564 (3.33)	-.0075 (-.45)	-.0060 (-.36)	.59	1.33
184, TOP SIRLOIN BUTT	1.84	1.8342 (59.77)	-.0310 (-12.40)	.1045 (3.18)	.2757 (8.39)	.5005 (15.24)	.4090 (12.46)	.1515 (4.62)	.79	1.57
193, FLANK STEAK	2.55	2.5588 (38.49)	.0074 (1.37)	-.0281 (-.40)	.0727 (1.03)	.0272 (1.03)	-.2402 (.38)	.1267 (-3.39)	.14	.84
180, STRIP LOIN	2.66	2.4358 (47.26)	.0011 (.26)	-.0335 (-.61)	.1922 (3.48)	.5261 (9.54)	.4159 (7.54)	.1725 (3.13)	.55	.88
112A, RIBEYE	3.22	3.2112 (68.09)	.0260 (6.79)	-.3321 (-6.57)	-.2823 (-5.59)	-.1966 (-3.90)	-.1164 (-2.31)	-.1903 (-3.77)	.44	.79
189, FULL TENDERLOIN	3.37	3.0510 (49.89)	.0585 (11.76)	-.1942 (-2.96)	-.1469 (-2.24)	-.0704 (-1.08)	-.1316 (-2.01)	-.2547 (-3.89)	.54	.47

<sup>a</sup> Average monthly wholesale price of cut / average monthly price of Boxed Beef composite price.

<sup>b</sup> Deviation from Nov-Dec.

<sup>c</sup> t - values in parentheses.



dicted results of many of the cuts without using price lagged as an independent variable.

These analyses were simplified by using the ratio approach. The demand equation is simply: Price Ratio depends on a constant, plus a trend, and on bimonthly periods. November-December was selected as a base so that all bimonthly variations were deviations from the November-December averages. For Brisket, the demand in all bimonthly periods except January-February were lower than November-December (Figure 6). This was statistically significant for all periods except March-April.

Armbone Chuck followed the same general price pattern as Brisket with demand clearly stronger in winter than summer and the same downward trend in demand relative to Boxed Beef Cut-Out (Figures 5 and 6). The mean price ratio for the period was only slightly higher than Brisket and about the same level as Boxed Beef Cut-Out producing a price ratio of 1.0 (Table 1).

Tables 1 and 2 differ in that Table 2 includes a lagged price variable which provided a better fit and improved statistical tests. The R-squared values were higher and the Durbin h values were acceptable except for Brisket and Top Round. These results indicate there is no significant serial correlation except for those two wholesale cuts. Lagged price interacted, however, with the trend and seasonal effects and tended to reduce or distort these estimates. The method used in Table 1 provided unbiased results for season and trend.

Bottom Gooseneck had essentially the same seasonal and trend pattern as the previous two cuts. These cuts take longer to prepare and generally must be baked or used for ground beef. The estimated seasonal pattern was very close to the actual ( $R^2 = .81$ ) and this pattern was quite consistent throughout the 11 years. The downward demand trend was even more pronounced than Brisket and Armbone Chuck (-.018 compared to Brisket at -.011 and Armbone Chuck at -.009, Table 1).

Knuckle had a clear downward trend in demand relative to all choice fed beef with seasonal demand higher in winter and lower in summer. This pattern was much the same for the preceding cuts but more erratic (Figure 5). Like previous cuts used mostly for roasts, the demand was highest from November through February (Table 1).

Top (Inside) Round had a clear downward trend in demand, but the seasonal pattern was less pronounced and more erratic than the lower priced cuts previously discussed. Clearly, all of the cuts discussed above need to be considered for alternative value-added uses to reverse downward trends in their value.

Top Sirloin Butt averaged about twice the value of Boxed Beef Cut-Out early in the period, but its significant downward trend resulted in an average ratio of 1.84 for the 11 year period (Table 1). This cut clearly had its highest demand in spring and summer with November-December being the lowest period. The seasonal pattern was surprisingly pronounced and regular (Figures 5 and 6).

During the 1980s, Flank Steak became popular for beef fajitas. The demand trend increased relative to Box Beef Cut-Out during the mid-1980s, but dropped back toward the end of the 1980s as Brisket, Chicken Breast, and other cuts of beef began to be used more for fajitas as well. The net demand trend is slightly positive during the 1980s, but not significantly different from zero for the entire period. Demand is somewhat erratic and appears to be the lowest in mid-summer, when it is hot in the Southwest (Table 1 and Figures 7 and 8).

As the analysis moves up the value scale to Flank Steak and Strip Loin the demand trend neared that of Boxed Beef Cut-Out. The strongest warm season demand for strip steaks during the year is the period which contains Memorial Day (Procopio). Apparently Memorial Day is the first big cookout week-end for many in the Northern States. May to August are clearly the periods of strongest relative demand for Strip steaks (May-June = .53, July-August = .42 compared to November-December = 0, Table 1 and Figure 7).

Ribeye clearly experienced an increasing demand trend during the 1980's period at a price ratio increase of 0.026 per month (Table 1 and Figure 7). Seasonal demand was erratic, but its highest relative price was in November-December and lowest in January to April. This cut had an average value of 3.22 times that of the Boxed Beef Cut-Out. It is a popular item in the restaurant trade as well as in the retail store trade (Table 1).

Full Tenderloin was the most expensive wholesale beef cut analyzed in the study at 3.37 times that of Boxed Beef Cut-Out. It had a strong increase in demand during the 1990s at a \$0.0585 (Table 1 and Figure 7). Being tender and lean, this cut is also a favorite restaurant item. Like ribeye, relative demand was highest in November-December (Figure 8). Seasonal demand was also erratic, and it appeared to be sensitive to economic conditions (as indicated by lower than average prices in the recession of the early 1980s and higher relative prices in the mid-1980's). Its demand may be related to business variations in the fine restaurant business.

The above analyses provides unbiased estimates of the trend in demand and changes in seasonal demand relative to all choice beef; however, the statistical properties in Table 1, as indicated by low DW

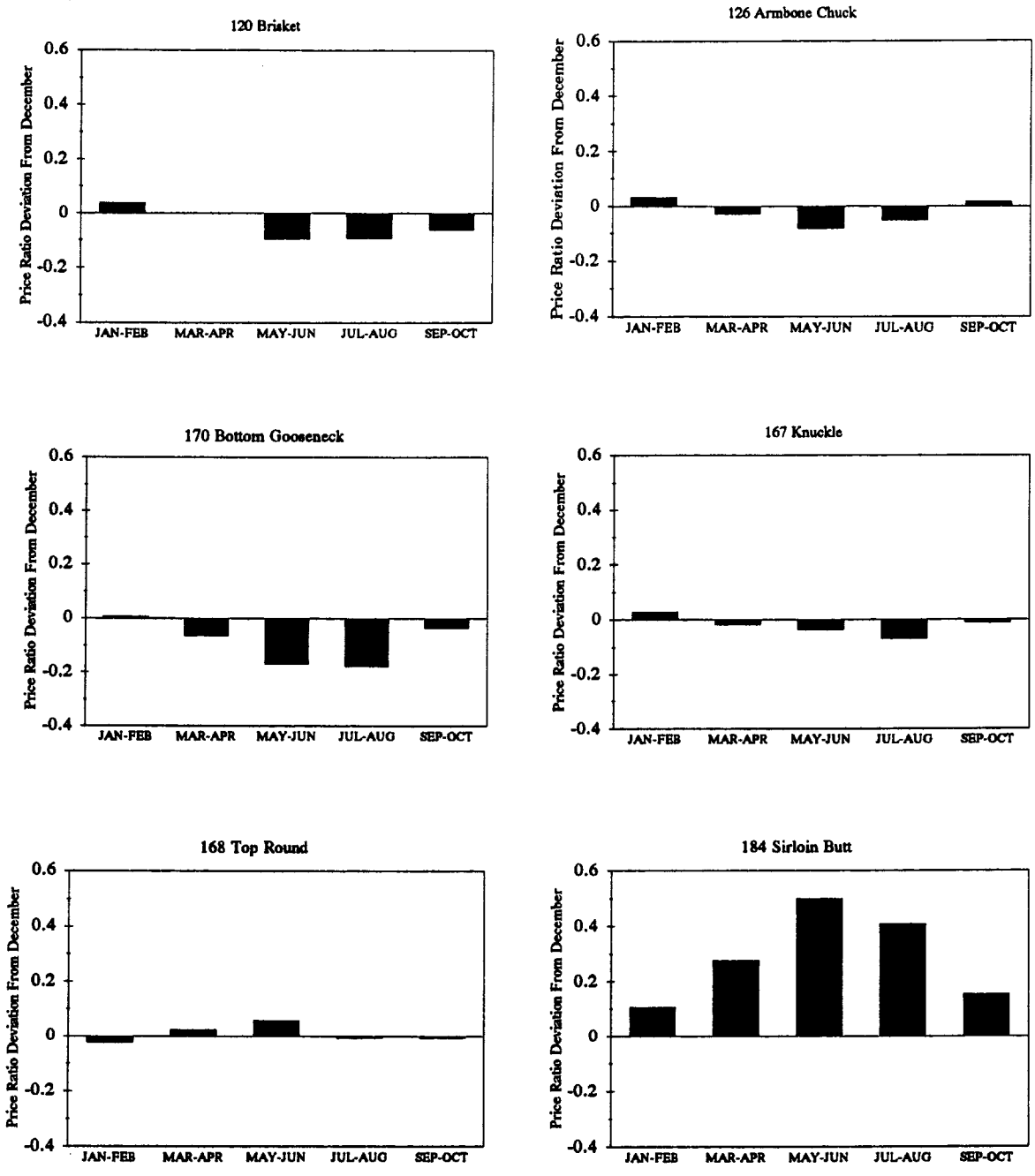


Figure 6. Seasonal Changes in Demand for Wholesale Cuts Relative to November-December, 1980 - 90. Price Ratio = Bimonthly Wholesale Price of Cut / Average Bimonthly Wholesale Price of Beef.

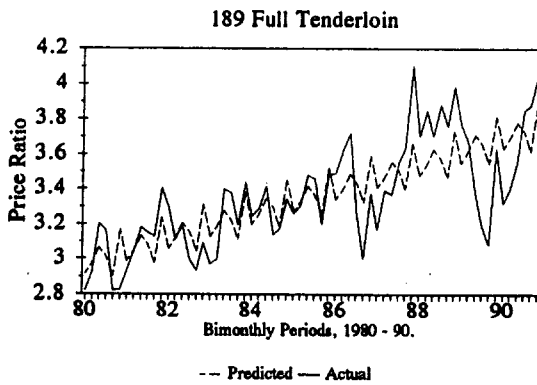
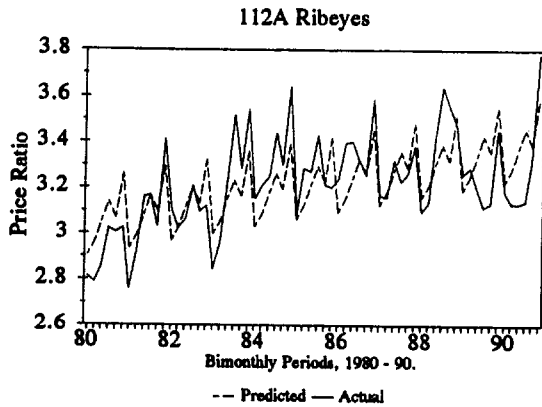
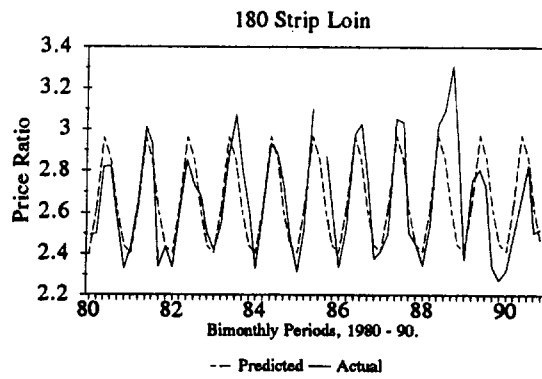
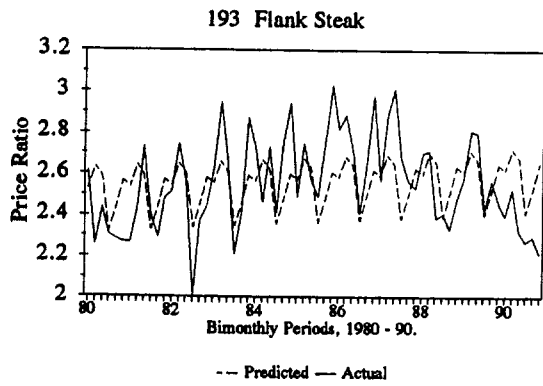
**Table 2**  
Price ratio of wholesale beef cuts, lagged and trend/seasonal model, 1980-90.

ITEM	MEAN RATIO <sup>a</sup>	INTER -CEPT	LAG PRICE	TREND	JAN-FEB <sup>b</sup>	MAR-APR <sup>b</sup>	MAY-JUN <sup>b</sup>	JUL-AUG <sup>b</sup>	SEP-OCT <sup>b</sup>	ADJ R2	Dh
FRESH 50% TRIMMINGS	.48	.110 (3.52) <sup>c</sup>	.793 (14.31)	-.001 (-1.34)	-.003 (-.23)	.006 (.47)	-.003 (-.22)	.025 (2.09)	-.027 (2.28)	.68	1.13
120, BRISKET	.98	.40 (5.36)	.65 (9.42)	-.004 (-2.95)	.007 (.55)	-.038 (-2.76)	-.081 (-6.05)	-.035 (-2.37)	-.035 (-2.60)	.75	-2.20
126, ARMBONE CHUCK	1.00	.326 (5.42)	.689 (12.74)	-.003 (-3.47)	.033 (4.29)	-.023 (-3.04)	-.030 (-3.37)	.009 (.94)	.039 (4.87)	.84	-1.29
FRESH 90% TRIMMINGS	1.07	.210 (3.59)	.796 (15.00)	-.0002 (-.16)	.038 (2.86)	-.003 (-.23)	-.011 (-.83)	.024 (1.82)	.0002 (.01)	.67	0.66
170, BOTTOM GOOSENECK	1.27	.527 (5.72)	.647 (10.48)	-.007 (-4.64)	.00003 (.0029)	-.051 (-4.68)	-.099 (-7.78)	-.052 (-3.28)	.030 (2.39)	.90	0.29
167, KNUCKLE	1.41	.749 (6.73)	.505 (6.85)	-.005 (-4.53)	.012 1.11	-.017 (-1.64)	-.027 (-2.58)	-.042 (-3.70)	.007 (.61)	.68	1.62
168, TOP (INSIDE) ROUND	1.48	1.015 (7.33)	.367 (4.26)	-.010 (-5.61)	-.026 (-1.59)	.031 (1.93)	.031 (1.81)	-.012 (-.77)	-.004 (-.28)	.64	2.96
184, TOP SIRLOIN BUTT	1.84	1.087 (7.49)	.398 (5.30)	-.019 (-6.01)	.134 (4.53)	.220 (7.13)	.358 (9.04)	.243 (5.69)	.060 (1.78)	.84	-0.70
193, FLANK STEAK	2.55	1.10 (5.67)	.58 (7.80)	.003 (.66)	-.054 (-91)	.054 (.92)	-.051 (-.86)	-.166 (-2.82)	-.029 (-.50)	.42	0.93
180, STRIP LOIN	2.66	.865 (5.08)	.625 (9.47)	.0006 (.19)	.047 (1.07)	.194 (4.59)	.340 (7.29)	.144 (2.83)	.037 (.836)	.73	1.06
112A, RIBEYE	3.22	1.471 (6.66)	.554 (8.00)	.012 (3.20)	-.274 (-6.48)	-.155 (-3.51)	-.073 (-1.66)	-.0950 (-2.3)	-.117 (-2.77)	.62	1.16
189, FULL TENDERLOIN	3.37	.724 (4.55)	.798 (15.01)	.012 (2.80)	-.257 (-6.43)	-.085 (-2.16)	-.074 (-1.89)	-.197 (-4.99)	-.168 (-4.24)	.83	1.63

<sup>a</sup> Average monthly wholesale price of cut / average monthly price of Boxed Beef composite price.

<sup>b</sup> Deviation from Nov-Dec.

<sup>c</sup> t - values in parentheses.



**Figure 7. Seasonal Demand and Demand Trend Relative to Boxed Beef Cut-Out for Selected Cuts of Wholesale Beef, 1980 - 90.**

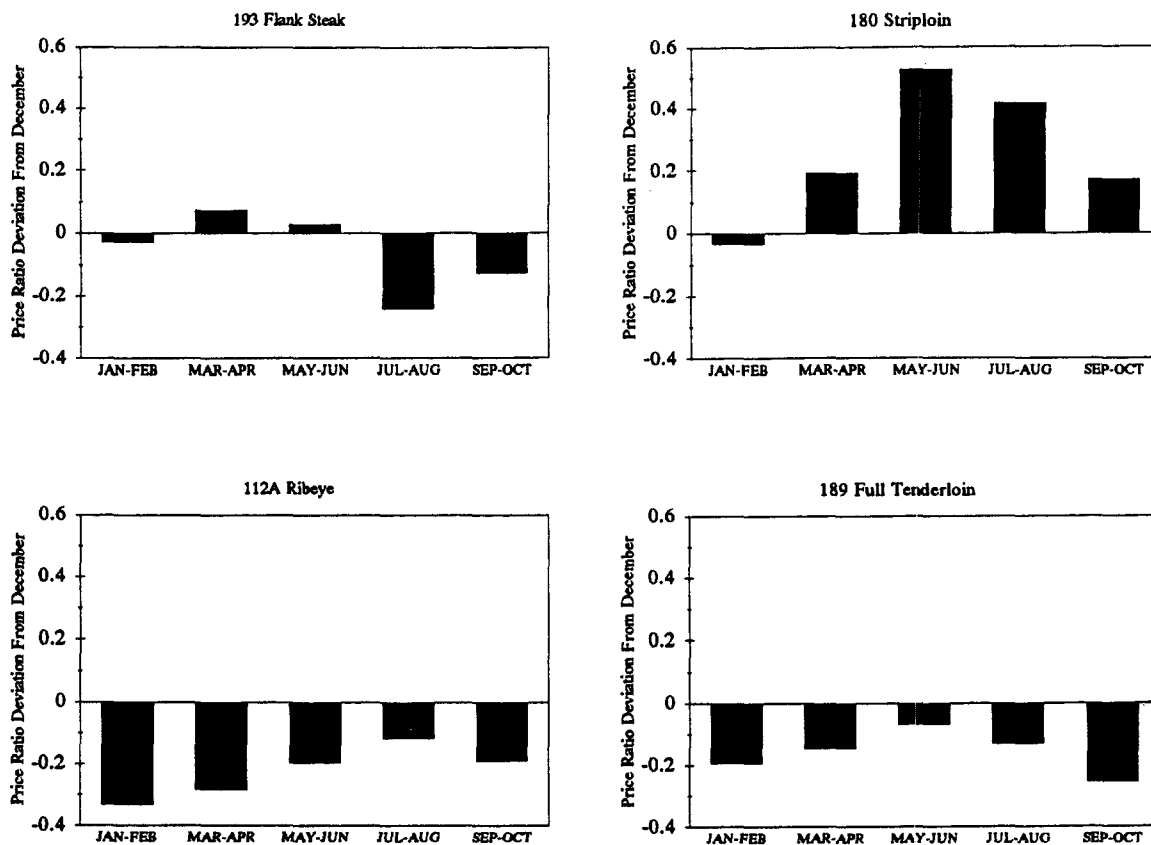


Figure 8. Seasonal Changes in Demand for Wholesale Cuts Relative to November-December, 1980 - 90. Price Ratio = Bimonthly Wholesale Price of Cut / Average Bimonthly Wholesale Price of Beef.

values and relatively low adjusted  $R^2$  values, are weak. If the price ratio, lagged one period, is considered in the analyses, the  $R^2$  are substantially improved. However, the lagged price ratio, by its nature, interacts with the trend and seasonal variables and generally reduces the trend effect and part of the seasonal effect (Table 1). The authors' judgement is that the more simple model used in Table 1 provides the best estimate of the trend and seasonal parameters.

### Conclusion And Recommendations

This approach to beef demand analysis isolates the demand trend and the seasonal demand of individual cuts by removing the overall variation in total beef supply and demand from the analysis. This was done by dividing the monthly price of each wholesale cut by the monthly Boxed Beef Cut-Out price. For most of the wholesale cuts, the seasonal effects and time trend in demand tracked the actual data (Figures 5 and 7). This study, as well as the previous study by Farris and Holloway, did not find a unique direct relationship to pork or to other individual wholesale cuts of beef. Theory and observation in the market suggest that a substitute relation exists, but the seasonal demand changes appear to be so strong they apparently mask the influence of other factors. This lack of finding substitution effects among beef cuts, as well as pork substitutes, suggests that in the very short run there may be little substitution effect, or that it occurs within the period of aggregation and therefore does not show up in weekly average prices. Most cuts showed a significant substitute relationship with chicken, however.

The graphs clearly show that a change in seasonal demand is responsible for the major part of price ratio fluctuations, because changes in the overall supply of beef on the subprimal price is removed by dividing the wholesale cut price by the Boxed Beef Cut-Out price. The supply of an individual cut is tied to the total supply of beef; therefore, when seasonal demand for that cut changes, it directly changes its price and its price ratio to Boxed Beef Cut-Out.

Since the lower valued cuts had a declining trend relative to all beef during the 11 year period, it is clear that there has been a trend toward decreased demand for lower quality cuts. The increased trend in the price ratio for higher valued cuts show a growing demand for quality. It appears there is an implied increase in the demand for convenience. Cuts that are used most for roasts had a declining relative demand while those cuts from the same primal or sub-primal, and used mostly for steaks, had a growing demand relative to all beef. Clearly the middle meats (Strip Loin, Ribeye, Tenderloin, and Top Sirloin Butt) of fed

cattle are responsible for a greater percentage of the value of the live animal as compared to a decade ago.

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Appendix Table 1

Price ratio of wholesale beef cuts, lagged price ratio, trend and month model, 1980 - 90.

ITEM	MEAN RATIO <sup>a</sup>	INTER -CEPT	LAG PRICE	TREND	JAN <sup>b</sup>	FEB <sup>b</sup>	MAR <sup>b</sup>	APR <sup>b</sup>	MAY <sup>b</sup>	JUN <sup>b</sup>	JUL <sup>b</sup>	AUG <sup>b</sup>	SEP <sup>b</sup>	OCT <sup>b</sup>	NOV <sup>b</sup>	ADJ R <sup>2</sup>
FRESH 50%, TRIMMINGS	.48	.090 (2.74) <sup>c</sup>	.803 (14.46)	-.001 (-1.23)	-.005 (-.29)	.027 (1.63)	.011 (.67)	.029 (1.76)	.015 (.88)	.009 (.55)	.032 (1.90)	.047 (2.82)	-.015 (-.92)	-.011 (-.67)	.029 (1.75)	.69
120, BRISKET	.98	.342 (4.66)	.702 (10.63)	-.003 (-2.72)	.01 (.55)	.006 (.37)	-.031 (-1.77)	-.046 (-2.72)	-.088 (-5.17)	-.066 (-3.72)	-.067 (-3.72)	.013 (.71)	-.055 (-3.18)	-.006 (-.31)	.006 (.34)	.79
126, CHUCK	1.00	.205 (3.28)	.794 (14.12)	-.002 (-2.34)	.061 (5.88)	.018 (1.8)	-.016 (-1.57)	-.02 (-2.01)	-.027 (-2.54)	-.006 (-.57)	.028 (2.42)	.018 (1.67)	.062 (5.94)	.032 (3.16)	.01 (.97)	.87
FRESH 90%,	1.07	.214 (3.82)	.804 (15.87)	-.00007 (-.08)	.002 (.13)	.047 (2.67)	.010 (.57)	-.042 (-2.32)	-.041 (-2.33)	-.005 (-.30)	.014 (.83)	.009 (.51)	-.007 (-.38)	-.018 (-1.01)	-.024 (-1.39)	.71
170, BOTTOM GOOSENECK	1.27	.473 (4.71)	.681 (10.17)	-.006 (-4.10)	.027 (1.82)	-.015 (-1.06)	-.041 (-2.86)	-.049 (-3.31)	-.086 (-5.55)	-.094 (-5.43)	-.065 (-3.34)	-.017 (-.87)	.047 (2.67)	.029 (1.96)	.010 (.73)	.91
167, KNUCKLE	1.41	.602 (5.35)	.606 (8.13)	-.004 (-3.83)	.031 (2.18)	-.021 (-1.45)	-.037 (-2.61)	-.008 (-.55)	-.03 (-2.13)	-.031 (-2.20)	-.058 (-4.03)	-.024 (-1.63)	.01 (.66)	.002 (.12)	-.01 (-.69)	.72
168, TOP ROUND	1.48	.995 (7.22)	.385 (4.49)	-.01 (-5.57)	-.024 (-1.07)	-.043 (-1.99)	-.001 (-.07)	.047 (2.19)	.049 (2.22)	-.007 (-.30)	-.035 (-1.62)	-.006 (-.27)	-.021 (-1.99)	-.004 (-.17)	-.016 (-.75)	.67
184, TOP SIRLOIN	1.84	1.128 (7.11)	.389 (4.66)	-.020 (-5.83)	.062 (1.54)	.171 (4.32)	.152 (3.64)	.261 (6.06)	.368 (7.65)	.325 (5.74)	.248 (4.30)	.216 (4.05)	.053 (1.06)	.041 (.98)	-.030 (-.75)	.85
193, FLANK STEAK	2.55	.930 (4.61)	.615 (8.29)	.003 (.62)	.017 (.21)	.015 (.19)	.134 (1.66)	.114 (1.42)	.117 (1.45)	-.086 (-1.07)	-.155 (-1.92)	-.026 (-.31)	.033 (.40)	.063 (.77)	.142 (1.76)	.45
180, STRIP LOIN	2.66	.792 (4.50)	.661 (9.57)	.0008 (.26)	-.066 (-1.12)	.120 (2.06)	.133 (2.29)	.216 (3.70)	.341 (5.65)	.278 (4.17)	.112 (1.61)	.105 (1.61)	-.008 (-.12)	.026 (.44)	-.040 (-.69)	.75
112A, RIBEYE	3.22	1.036 (4.65)	.686 (10.05)	.008 (2.57)	-.335 (-3.4)	-.155 (2.76)	-.040 (.70)	-.169 (-3.11)	-.080 (-1.43)	.032 (.596)	-.031 (-.60)	-.108 (-2.06)	-.188 (-3.57)	.029 (.53)	.040 (.77)	.70

<sup>a</sup> Average monthly wholesale price of cut / average monthly Boxed Beef composite price.

<sup>b</sup> Deviation from December.

<sup>c</sup> t - values in parentheses.



