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# **STRUCTURAL CHANGE IN LIVESTOCK: CAUSES, IMPLICATIONS, ALTERNATIVES**

**Wayne Purcell, Editor**

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# STRUCTURAL CHANGE IN LIVESTOCK: CAUSES, IMPLICATIONS, ALTERNATIVES

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## PREFACE

This book is a report of research and a listing of research literature in the general area of livestock pricing. The emphasis in Chapters 1-3 is on the "structure" issues, and John Rowsell has made a special effort to capture the recent literature dealing with structure, integration, performance, etc. in the annotated bibliography.

The research reported in Chapters 1-3 was partly financed by a grant from Agricultural Marketing Service of the U.S. Department of Agriculture. The grant was at the initiative of the Colorado Cattle Feeder's Association and has been administered through the Colorado Department of Agriculture. The Research Institute on Livestock Pricing has been involved to conduct and/or coordinate the research. On behalf of Clement Ward, Michael Hudson, and the Research Institute on Livestock Pricing, I extend a special "thank you" to the Colorado Cattle Feeder's Association. The research called for in the grant is an important part of Session 1 of the national conference for which this book is being prepared.

We need more coalitions of this type to help ensure the needed research will get done. Contact the Research Institute if we can be of assistance.

Wayne D. Purcell, Director  
Research Institute on Livestock Pricing

# CHAPTER 1: STRUCTURAL CHANGE IN THE LIVESTOCK SECTOR: CAUSES, IMPLICATIONS, CONTINUING ISSUES

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## *Introduction*

Consolidation in the meatpacking and meat processing sectors emerged as a major economic issue in the 1980s. Acquisitions and mergers that were allowed by the federal regulatory agencies and approved in the courts were applauded in some sectors of the industry and viewed with growing alarm in others. Arguments that the consolidation was a naturally occurring economic phenomenon and would benefit the industry were countered by concerns over the market power that was being accumulated in the hands of a few, giant firms.

The levels of consolidation and concentration that have emerged are without precedent, especially in the beef and lamb sectors. As we move into the 1990s, the four largest packers are doing approximately 80 percent of the boxed beef business, and the 4-firm concentration ratio is almost as high in sheep and lamb slaughter. Concentration is increasing rapidly in fed steer and heifer slaughter. Table 1 records pertinent data through 1988.

There is little question that the structural changes will exert significant influence on the way the meat sector does business. With the consolidation has come a surge in contractual procurement of fed cattle. Pack-

Table 1. The 4-Firm Concentration Ratios for Selected Classes of Livestock Slaughter and Meat Production

Year	Steers and Heifers	Sheep and Lambs	Boxed Beef
(Percent)			
1978	30	56	50
1979	35	64	51
1980	36	56	53
1981	40	52	57
1982	41	44	59
1983	47	44	60
1984	50	49	62
1985	50	51	62
1986	55	54	68
1987	67	75	80
1988	70	77	79

SOURCE: Packers and Stockyards Administration, Agricultural Marketing Service, U.S. Department of Agriculture.

ers and large feedlots are forming working alliances. Federal agencies reporting market activity are starting to report the level of contractual activity. There are emerging concerns about the adequacy of the base of competitively discovered prices as the transfers of cattle, hogs, and slaughter lambs are increasingly internalized by the large packers. Producers, especially the smaller producers, are wondering aloud what the future holds for them. A proposal to move to cash settlement in the live cattle futures has been put on hold, apparently due to concerns about possible manipulation in an increasingly "thin" cash market for fed cattle (Kahl, Hudson, and Ward). The consolidation is indeed exerting significant and pervasive influence on the industry.

Much of the discussion relates ultimately to the issue of "efficiency" versus "market power". Theoretically, large size brings economies and lower op-



erating costs. Also, theoretically, large size brings the power to influence price and other terms of the exchange process. There is a need to examine empirically which of the theoretical tenets hold true in the livestock sector. Examination of the implications of the massive consolidation will be an important part of the research agenda in the 1990s.

There is also a need to examine the issues surrounding the consolidation in a broader context than just the efficiency-market power trade offs. Conceptually and empirically, what prompted the structural change? Was it due to economic forces largely beyond the control of industry participants and trade groups? What implications does the consolidation have to the long-range economic viability and competitive position of the traditional red meat sector? In addition to the readily observable changes in firm behavior, what impact will the changes exert on day-to-day demand for livestock, on the supply and price of the product offered to consumers, and on the overall effectiveness of pricing and price discovery processes? In the changed structure, will there be more interest in, and need for, risk transfer instruments and forward pricing?

The objective of this chapter is to examine, in a broad context, the issues surrounding the continuing consolidation. The conceptual and analytical base established here will be designed to lead into the more specific analyses of the impact of structural change on industry performance to be reported in Chapters 2 and 3. Chapter 4 provides an extensive annotated bibliography of research in the livestock pricing area, including research dealing with structural change and its implications.

## *A Catalyst for Change*

The motivations underlying mergers and acquisitions will always be broad and complex, but there is typically a single development that accentuates the process. In the red meats, the move toward consolidation gathered momentum during the period in which consumer-level demand decreased significantly. *Those decreases in demand are hypothesized to be the single most important causal factor in the structural changes of the 1980s.* In fact, the argument will be made that the consolidation toward fewer and larger firms was an inevitable result of what happened to demand for beef, pork, and lamb.

The impetus for change was apparently the greatest in the beef sector. Table 2 records per capita consumption and related price data for the

1970 to 1988 period. The most casual observation suggests problems started in 1979.

Table 2. Per Capita Consumption and Price of Choice Beef at Retail, Actual and Deflated (CPI, 1982-84 = 100), 1970-1988

Year	Per Capita Consumption	Retail Price	Deflated Retail Price
	(lbs. retail weight)	(cents/lb.)	(cents/lb.)
1970	84.4	98.6	262.0
71	83.7	104.3	267.0
72	85.5	113.8	283.8
73	80.5	142.1	319.8
74	85.4	146.3	296.7
75	88.0	154.8	287.7
76	94.2	148.2	260.4
77	91.4	148.4	244.9
78	87.2	181.9	278.9
79	78.0	226.3	311.8
80	76.4	237.6	288.4
81	77.1	238.7	262.5
82	76.8	242.5	251.3
83	78.2	238.1	239.0
84	78.1	239.6	231.1
85	78.8	232.6	216.3
86	78.4	230.7	210.4
87	73.4	242.5	213.4
88	72.1	254.7	215.3

From 1979 through 1986, nominal retail prices for Choice beef were essentially "flat" between \$2.30 and \$2.50, and the inflation-adjusted or deflated retail prices (CPI, 1982-84 = 100) had to decline over 30 percent to entice the consumer to accept essentially a constant per capita supply. These developments occurred during a period in which overall price inflation, as measured by the Consumer Price Index (CPI), reached annual rates of increase in excess of 10 percent.

There has been some debate in the economic literature about whether the structural demand for beef has in fact shifted and/or what the causal forces might be. Some of the issues are discussed in an article I wrote for *Choices* and I attempted, in a separate analysis, to model developments in demand for the red meats and broilers. Both publications are listed in the references at the end of the chapter, and both will direct the interested reader to other selected publications in this area.

In the more formal analytical effort (*Research Institute on Livestock Pricing, Bulletin 1-89*), any attempt to model the demand for beef across the 1960-88 time period in either a price-dependent or quantity-dependent context employing the traditional economic demand shifters proved unsatisfactory. During the 1977-87 period, in particular, changes in income and changes in per capita consumption or prices of related products were not adequate to explain the variation in beef prices or in per capita beef consumption. Analysis of the residuals from single-equation models that included only the traditional economic shifters (price, price of competing products, and incomes for quantity-dependent models, to illustrate) and measures of seasonal patterns exhibited non-independent patterns starting in 1977.

From 1979 through 1987, poultry prices increased relative to beef prices. Pork prices also increased relative to beef prices during the period, and inflation-adjusted consumer incomes trended higher. Those forces would be expected to *increase* beef demand, but inflation-adjusted beef prices declined sharply in the presence of essentially constant per capita supplies. There was apparently a preference shift during the period that was forcing a departure from the traditional economic relationships.

The final specification for a single-equation, price-dependent model for beef is shown in Table 3. Yearly shift variables (0-1 dummy variables) are employed starting in 1977. Definitions for the explanatory variables are:

- BEEFDEF: Deflated (CPI, 1982-84=100) retail beef prices (cents per lb.);
- BEEFCON: Per capita beef consumption, retail weights (lbs.);
- PORKCON: Per capita pork consumption, retail weights (lbs.);
- BROICON: Per capita chicken consumption, retail weights (lbs.);
- DEFINC: Deflated (CPI, 1982-84=100) per capita disposable income (\$);
- QDUM2: Dummy variable with value 1.0 for quarter 2 observations;
- QDUM3: Dummy variable with value 1.0 for quarter 3 observations;

- QDUM4: Dummy variable with value 1.0 for quarter 4 observations; and
- DUM77-DUM87: Dummy variable with the value 1.0 for all quarters of each respective year, 1977-87, zero otherwise.

The BROICON variable was not statistically significant but was retained in the model on theoretical grounds. The seasonal dummies were also not statistically significant, but were retained on theoretical grounds. Conceptually, the influence of chicken consumption and some allowance for a seasonal pattern in beef prices should be included in the model. All the yearly "shift" dummies except DUM79 were highly significant, and DUM79 was retained to preserve continuity in the yearly shift specification.

*The results suggest intercept levels for the model in the late 1970s and 1980s depart significantly from the overall model intercept.* The increases in absolute size of the estimated beta coefficients for the shift dummies in the later years statistically confirm what visual inspection of the data in Table 2 suggests -- that the *level of demand* for beef was declining on a year-to-year basis from the late 1970s through 1987.

Whether the model presented in Table 2 is the correct specification could be debated, but that is not the intent here. The data and the analytical effort support an inference that demand for beef decreased in a progressive fashion across the 1977-87 time period.<sup>1</sup>

Consumer concerns about eating habits, fat levels, cholesterol, and the increasing demand for convenience have all been discussed in the literature as possible reasons for the changes. All those possibilities are preference-related. It *could* be, of course, that the relationships among the competing meats and between beef and income levels are changing. But if the "structural parameters" such as cross elasticity and income elasticity have in fact changed, those changes must still be related back to the possibility of change in preference patterns. Decisions among meats and how income will be spent must still be made, and those decisions are driven by the preference patterns of consumers.

---

<sup>1</sup> Out-of-sample tests for the four quarters of 1988, using the coefficient for the 1987 shift variable (DUM87), suggest demand for beef started to stabilize in 1988. The price-quantity relationships in Table 2 suggest the same thing. Per capita supplies were down 1.0 percent, and deflated retail prices were up 1.0 percent. That year-to-year pattern is roughly consistent with a retail level demand elasticity around -.67 and thus support an inference of a "stable demand" across 1987 and 1988.

Table 3. Summary Statistics and Estimated Beta Coefficients for the Final Price-Dependent Model, Beef, 1960-87

Dependent Variable	BEEFDEF		
Standard Error of Regression	8.371		
R-squared	.907		
Adjusted R-squared	.889		
F Statistic (7, 104)	50.533		
Probability Value for F	.000		
Mean Squared Error	6517.11		
Durbin-Watson Statistic	1.488		

Variable	Coefficient	T-Ratio	Prob > T
INTERCEPT	331.003	18.237	.000
BEEFCON	-12.615	-10.403	.000
PORKCON	-3.264	-4.002	.000
BROICON	-1.150	-.416	.678
DEFINC	.028	9.463	.000
QDUM2	-2.039	-.566	.573
QDUM3	4.064	1.200	.233
QDUM4	-1.627	-.698	.487
DUM77	-31.895	-6.833	.000
DUM78	-20.590	-3.680	.000
DUM79	-5.719	-.659	.512
DUM80	-20.255	-2.275	.025
DUM81	-45.281	-4.696	.000
DUM82	-55.510	-5.620	.000
DUM83	-72.756	-6.943	.000
DUM84	-94.267	-8.350	.000
DUM85	-109.908	-8.845	.000
DUM86	-130.448	-10.024	.000
DUM87	-147.145	-9.109	.000

The references cover this area in more detail. The book edited by Buse provides a broad and comprehensive coverage. The purpose here is to

document the very real possibility of significant preference-related changes in demand for beef, and to look at those changes as a primary catalyst for the industry-wide consolidation.

The economic interrelationships are apparent. With retail prices essentially "capped" by the refusal of consumers to pay higher nominal prices, any increase in costs at the packing-processing level would be expected to decrease the derived demand for cattle at the producer level and reduce cattle prices. With overall price inflation periodically exceeding 10 percent per year during the period, there are reasons to argue the middleman's costs (labor, materials, refrigeration, interest, transportation, etc.) were in fact being pushed higher.

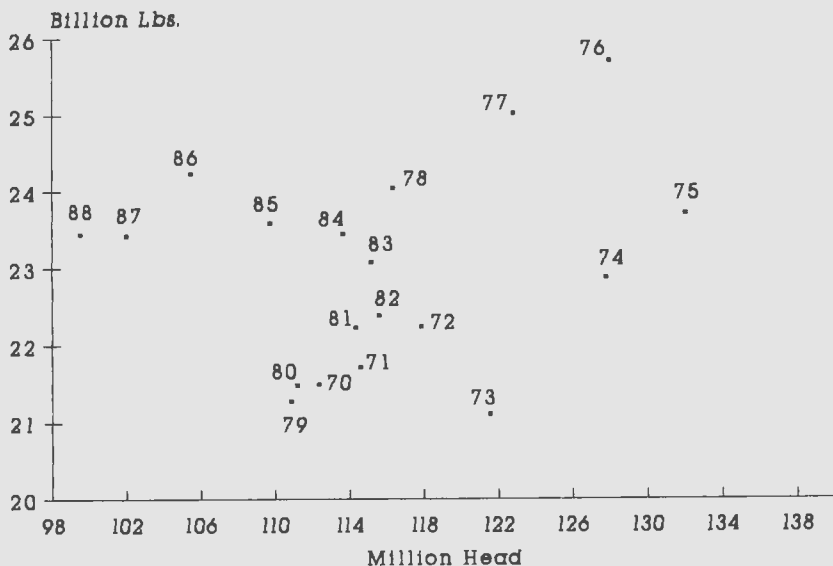
Pressures associated with constant retail prices and inflated costs could be minimized at two levels in the beef sector:

1. Efficiency at the producer level could be increased. Any adjustments that boost productivity per unit of input would help to reduce costs or constrain cost increases. Increased efficiency and reduced operating costs would ease the price pressures on the producer coming from the "capped" retail prices and allow more producers to stay in business.
2. Increased efficiency in the processing function (killing, breaking, distribution, etc.) would lower per unit costs. Adjustments that reduce processing costs would reduce the pressure on the packer-processor to protect operating margins or target returns on investment by pushing down the prices of cattle.

Figure 1 suggests increased productivity and increased efficiency at the producer level was impressive. Commercial beef production in 1988, from a January 1 inventory near 99.5 million head, approached production levels in 1978 when the inventory was near 116 million head. Production in 1988 actually exceeded production in the early 1980s when the herd was above 114 million head. Cattle types have been changed, slaughter weights are higher without destroying carcass cutability, and a high percentage of the cattle are moving through feedlot programs. The impressive advances in an industry where biological constraints mean change will tend to come slowly is also an indirect measure of the intensity of the pressure on producers as they sought cost-reducing technology in an effort to survive.

Figure 2 provides a useful proxy measure of progress at the processing level. The farm-retail price spread published by the USDA is not a

Figure 1. Commercial Beef Production  
Related to January 1 Inventories

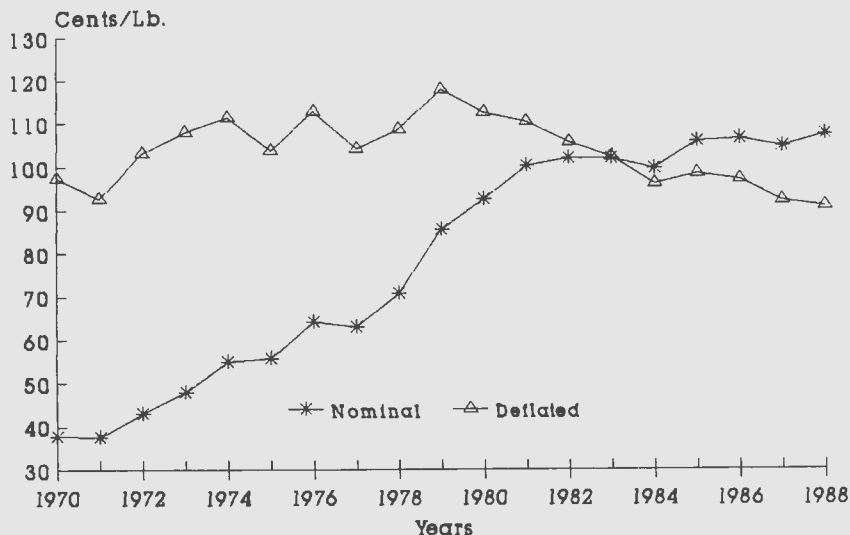


measure of the operating margins at the packing-processing level, but it will reflect changes in per unit costs over time. With retail prices "capped", the packer must respond to tendencies toward inflated costs by accepting a smaller operating margin, pushing cattle prices lower, or increasing operating efficiency. Across the late 1970s and 1980s, the nominal or reported spreads were essentially flat and the inflation-adjusted farm-retail spreads trended significantly lower. *If the inflation-adjusted price spreads had remained constant, suggesting nominal price spreads had moved higher with overall price inflation during the period, the downward pressure on cattle prices would have been even more intense.*

The impressive increases in productivity and efficiency at the producer and processor levels were not sufficient to offset all the problems, however. Prices at the producer level came under pressure, and the result was a cost-price squeeze that drove many producers out of business. Figure 3 records the nominal and inflation-adjusted prices for Choice fed steers at Omaha, and Figure 4 shows comparable measures of feeder steer prices at Kansas City.

The surge in cattle prices in 1979 was associated with a short-lived pause in the herd liquidation that had started in 1976. But the problems on the

**Figure 2. Nominal and Deflated (CPI, 1982-84=100), Farm-Retail Price Spreads for Beef, 1970-88**

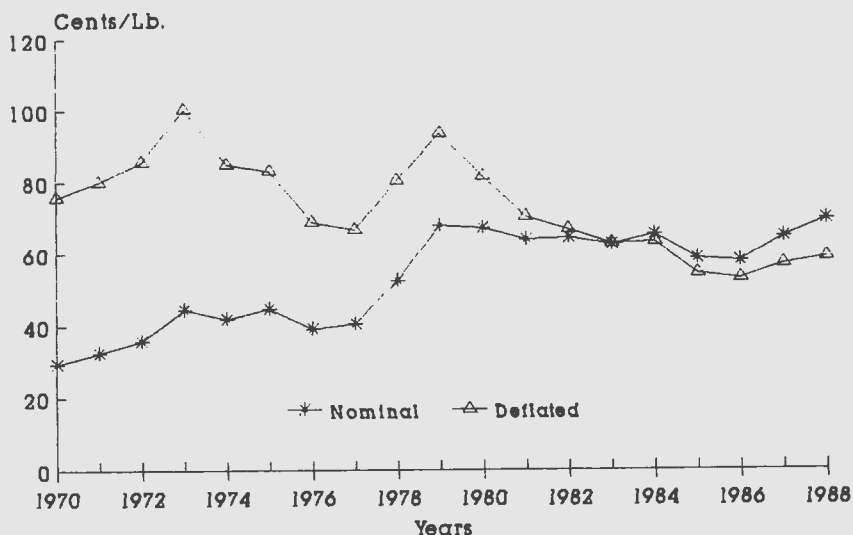


demand side quickly offset price boosting influences of the developing herd-building tendencies, and prices drifted lower. During the 1980s, nominal prices were flat to lower, and the deflated price series for both fed cattle and feeder cattle trended downward. Pressures at the producer level intensified, and forced disinvestment and herd liquidation were continued until the total cattle numbers were pushed below 100 million head in 1988 and 1989. Table 4 records total cattle numbers and the beef cow herd from 1960 through 1989.

Much of the observed consolidation in the beef sector was during the 1977-88 period. It is apparent that the time period was characterized by cost-price squeezes and the economic pressures originating from demand problems at the consumer level. Adjustment was inevitable, and there was pressure to "get cheap or get out", especially at the packing-processing level. In that type of setting, it is apparent why firms were looking to get larger to capture economies of size. Mergers and acquisitions were the quick way to get larger, and that route was apparently preferred to building new capacity in a packing-processing sector that already faced problems of excess capacity. Concentration ratios increased with every merger/acquisition that was completed.



**Figure 3. Nominal and Deflated Prices  
(CPI, 1982-84=100), Choice Steers,  
Omaha, 1970-88**



**Figure 4. Nominal and Deflated Prices  
(CPI, 1982-84=100), 600-700 Pound Feeder  
Steers, Kansas City, 1970-88**

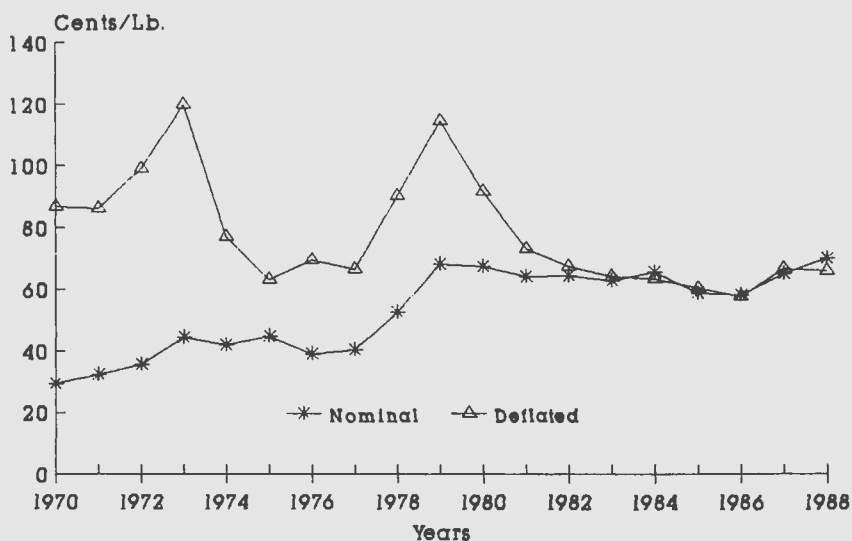
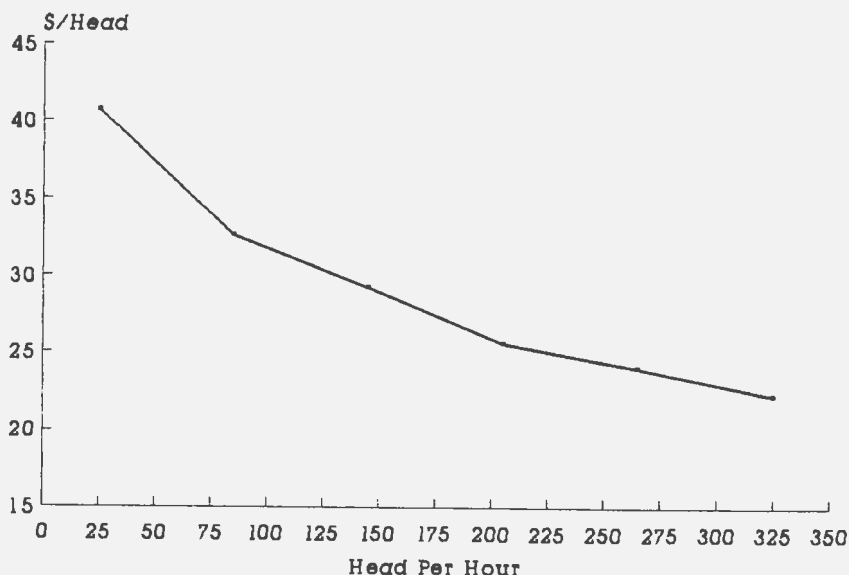


Table 4. Total Cattle Inventory and the Beef Cow Herd, U.S.,  
1960-1989

Year	Total Cattle Numbers	Beef Cow Herd
	(1,000 Head)	
1960	96,236	26,344
1961	97,700	27,327
1962	100,369	28,691
1963	104,488	30,589
1964	107,903	32,794
1965	109,000	34,238
1966	108,862	34,442
1967	108,783	34,708
1968	109,371	35,565
1969	110,015	36,511
1970	112,369	36,689
1971	114,578	37,878
1972	117,862	38,810
1973	121,539	40,932
1974	127,788	43,182
1975	132,028	45,712
1976	127,980	43,901
1977	122,810	41,443
1978	116,375	38,738
1979	110,864	37,062
1980	111,242	37,107
1981	114,351	38,773
1982	115,444	39,230
1983	115,001	37,940
1984	113,700	37,494
1985	109,801	35,393
1986	105,468	33,633
1987	102,000	33,779
1988	99,524	33,112
1989	99,484	33,669

Figure 5 suggests the moves to larger firm sizes did in fact cut costs, and this is the likely source of the efficiencies that allowed the deflated farm-retail price spreads for beef to decrease significantly. Ward's (*Meatpacking Competition and Pricing*) estimates of the average cost curves for beefpacking plants suggests per unit costs continue to decline up to annual kill volumes that translate to 300 to 350 head per hour. Fifteen years ago, plants that could kill 100-150 head per hour were considered "large". But technology has advanced rapidly, and one alternative facing the packer-processor as the pressures of "capped" prices filtered down through the system was to go after the still untapped economies of size. Viewed in that context, the mergers and acquisitions of the past decade were, it could be argued, inevitable and were an expected response to economic pressures.

Figure 5. Estimated Costs of Cattle Slaughter By Size of Operation



Those who supported the consolidation have understood this point, and their argument runs something like this:

**The beef industry would be smaller, at all levels, as we move to the 1990s if the efficiencies associated with the consolidation had not been captured.**

And there *is* impressive support for the argument. It *is* true that the farm-retail price spreads have not moved up with the overall price inflation rate, and there can be little doubt that such an impressive performance is related to the economies of procurement, killing, breaking, and distribution accruing to the larger firms. Capacity has been protected, and the herd size and market share in the beef sector are, it can be forcefully argued, larger than they would have been if the consolidation had not occurred.

In the pork sector, developments ran in the same direction but were less dramatic. The demand problems that rocked the beef sector were present in pork as well, however, and adjustments appear to have paralleled what occurred in beef.

Table 5 shows per capita consumption and related price data for pork. Observation suggests dramatic developments on the demand side occurred in 1980 and 1981. Inflation-adjusted prices for pork in 1981 were below those for 1980 in the presence of a large year-to-year reduction in per capita supplies. Then, during the 1980s, year-to-year comparisons show other periods in which constant or even reduced per capita supplies were accepted by consumers only at lower inflation-adjusted prices. In 1984, for example, both deflated *and* nominal prices were lower in the face of a year-to-year decrease in per capita supplies.

Figure 6 shows the relationship between commercial pork production and December 1 inventories (for the previous year). It is apparent that increased production efficiency was also realized in the hog sector. The coordinate for 1988, for example, compares very favorably with those in the late 1970s. Production in 1988 exceeded that of 1979, and the 1979 inventory was over 6 million head (over 10 percent) larger than in 1988.

There was apparently less progress in increased efficiency at the packer-processor level. Figure 7 shows nominal and deflated farm-retail price spreads for pork through 1988. The nominal price spreads move higher throughout the 1980s, and the inflation-adjusted spreads do not show the downward trend that was apparent in beef.

Table 5. Per Capita Consumption and Price of Pork at Retail, Actual and Deflated (CPI, 1982-84 = 100), 1970-1988

Year	Per Capita Consumption	Retail Price	Deflated Retail Price
	(lbs. retail weight)	(cents, lb.)	(cents/lb.)
1970	62.3	77.4	199.4
71	68.3	69.8	172.4
72	62.9	82.7	197.7
73	57.3	109.2	245.8
74	61.8	107.8	218.6
75	50.7	134.6	250.1
76	53.7	134.0	235.4
77	55.8	125.4	207.0
78	55.9	143.6	220.1
79	63.8	144.1	198.6
80	68.3	139.4	169.2
81	65.0	152.4	167.6
82	59.0	175.4	181.7
83	62.2	169.8	170.5
84	61.8	162.0	156.3
85	62.1	161.9	150.6
86	58.6	178.4	162.7
87	59.2	188.4	165.8
88	63.1	183.4	155.0

There will be a tendency for some to argue the absence of increased efficiency at the processing level in pork was due to the fact that less consolidation was occurring, and there were therefore fewer "economies of size" captured by the pork sector. But that conclusion could be debated. There is also the possibility that the demand problems in pork were slightly less intense, were of shorter duration, and that the pressures to adjust were accordingly less severe.

Table 6 records a price-dependent model for pork that is adapted from my analytic efforts referenced earlier. The data base was quarterly observations from 1960 through 1988. As was the case with beef, efforts to explain price and/or per capita consumption of pork during the 1977-87

Figure 6. Commercial Pork Production  
Related to December 1 Inventories

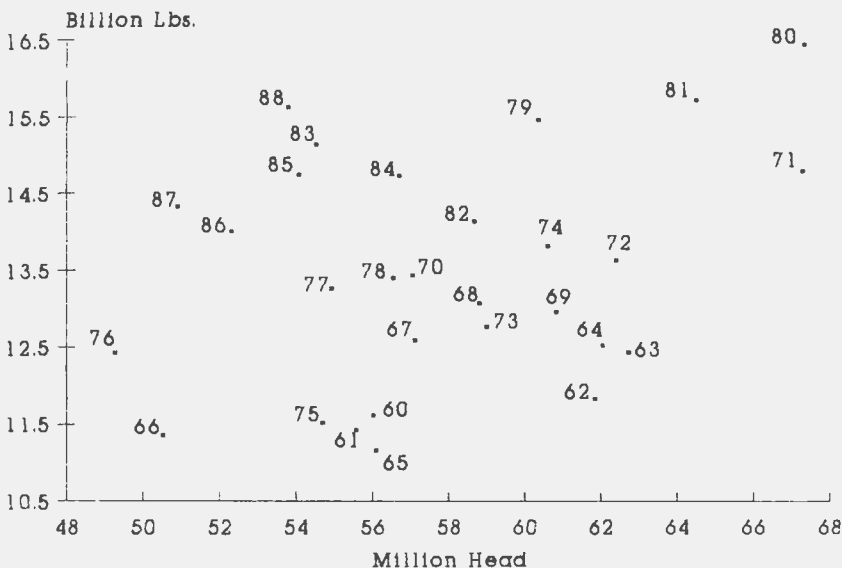
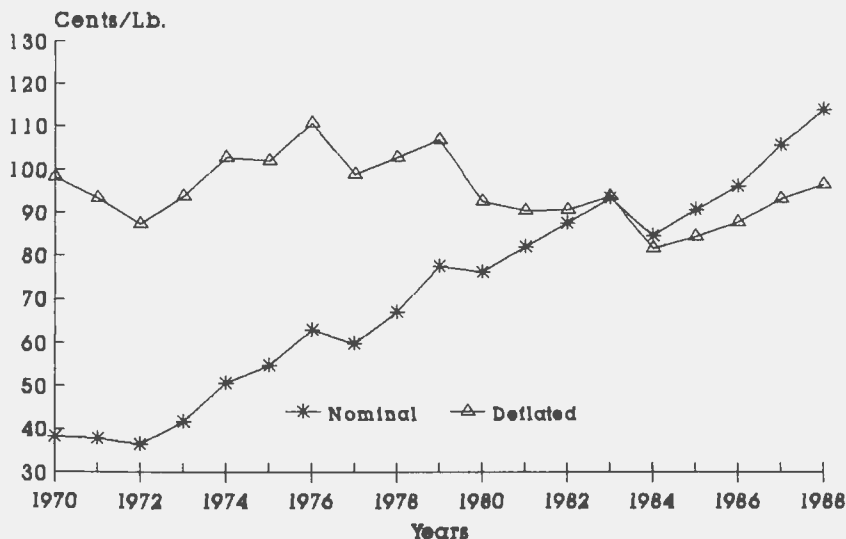


Figure 7. Nominal and Deflated (CPI,  
1982-84=100), Farm-Retail Price Spreads  
for Pork, 1970-88



period with the traditional economic forces proved unsuccessful. The final model specification included the yearly "shift variables" employed in the efforts to model the beef sector. The results are shown in Table 6. The PORKDEF variable is deflated (CPI, 1982-84 = 100) retail pork prices in cents per pound. The other variables are as defined earlier in discussing the beef model. The BROICON variable and the seasonal variables (QDUM -- QDUM4) are more significant in a statistical context than they were for the beef model. As was the case with beef, DUM79 was not significant but was retained in the model to maintain continuity in the yearly shift variables.

*Generally, starting in the late 1970s, the shift variables suggest the intercepts would be significantly below the intercept for the overall model.* The estimated beta coefficients tend to be larger in absolute value into the 1980s, the same pattern that was observed in the beef model. But the beta coefficient for 1987 shows signs of improvement relative to 1986, and tends to confirm what observation of the data in Table 5 suggests. Pork demand apparently reversed the long-standing negative trend and increased in 1987 compared to 1986. The data in Table 5 suggest another year-to-year increase in demand from 1987 to 1988 (using a demand elasticity coefficient of -.67) and the out-of-sample tests, for the four quarters of 1988, using the model shown in Table 6 (and DUM87) tend to confirm the year-to-year increase. The model predicted quarterly prices for the four quarters of 1988 that were generally below the observed inflation-adjusted prices, suggesting that the underlying "preference" problem was starting to improve.

Analysis thus suggests the demand problems in pork were less significant in terms of magnitude and duration than in beef, but the empirical evidence clearly documents the presence of problems. Figure 8 records nominal and deflated hog prices using the widely reported 7-market cash price series. There was pressure on prices at the producer level, and the deflated price series works sharply lower during the 1980s compared to the 1970s.

The pattern of forced disinvestment and industry contraction that was so apparent in beef is also present in pork. Table 7 records the U.S. hog numbers by years (using December 1 inventories for the previous year) through 1989. Numbers trended lower throughout the decade of the 1980s before showing signs of turning higher in 1988. The demand problems prompted adjustments in pork just as they did in beef.

In summary, it appears the economic pressures surrounding decreases in demand for beef were a major catalyst in the consolidation of the 1980s.

Table 6. Summary Statistics and Estimated Beta Coefficients for the Final Price-Dependent Model, Pork, 1960-87

Dependent Variable	PORKDEF		
Standard Error of Regression	9.1452		
R-squared	.90629		
Adjusted R-squared	.88935		
F Statistic (17, 94)	53.4780		
Probability Value for F	.000		
Mean Squared Error	7861.6373		
Durbin-Watson Statistic	1.4570		

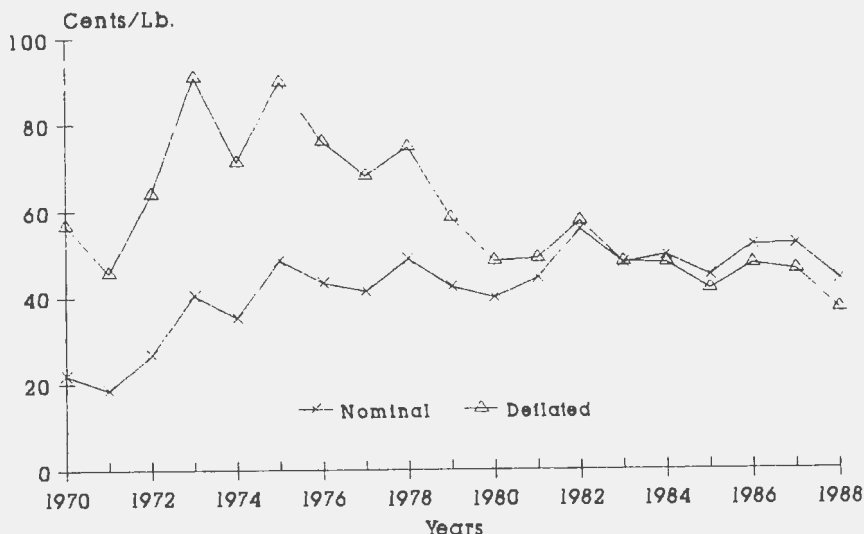
  

Variable	Coefficient	T-Ratio	Prob > T
INTERCEPT	346.178	17.919	.000
BEEFCON	-1.3198	-1.327	.18783
PORKCON	-14.8202	-16.711	.000
BROICON	-8.19587	-3.892	.00019
DEFINC	.01989	6.218	.000
QDUM2	-6.8639	-2.070	.04117
QDUM3	-2.8960	-.848	.39843
QDUM4	12.0369	4.746	.000
DUM77	-25.5588	-5.067	.000
DUM78	-14.4206	-2.724	.00769
DUM79	.8659	.142	.88716
DUM81	-17.0229	-2.620	.01025
DUM82	-22.3036	-3.044	.00303
DUM83	-24.3856	-3.467	.00079
DUM84	-44.7703	-6.099	.000
DUM85	-46.4742	-5.863	.000
DUM86	-52.2949	-6.272	.000
DUM87	-44.8423	-4.516	.00002

Packers grew larger seeking economies of size, and mergers and acquisitions were apparently the quickest and easiest route to follow. Concen-



**Figure 8. Nominal and Deflated Hog Prices, (CPI, 1982-84=100), 7-Markets, 1970-1988**



tration ratios increased accordingly, and four firms are now doing 80 percent of the boxed beef business.

In pork, there was less consolidation, perhaps because the demand problems were less severe and of shorter duration. With recent years (1987-89) suggesting the demand for pork is now increasing, some of the emerging pressure to consolidate in that sector may be relieved. It is revealing to note, however, that the farm-retail price spreads in pork during the 1980s do not imply the presence of increased efficiencies in pork paralleling those that were apparently realized in beef.

**The consolidation that has occurred in meatpacking, especially in the beef sector, has been an expected response to economic pressures. Significant decreases in demand, starting in the late 1970s, created an environment in which increased efficiency and reduced costs of operation were essential to survival for producers and packers. Mergers and acquisitions were the quick and perhaps the easiest route to larger firm size and the economies that came with large-scale operations. The consolidation was an inevitable response to the declining demand and related economic pressures.**

Table 7. December 1 Hog Numbers: Total, Breeding, and Market, 1970-88

Year	Total	Breeding	Market
(1,000 Head)			
1970	67,285	9,645	57,640
71	62,412	8,475	53,937
72	59,017	8,650	50,367
73	60,614	8,605	52,009
74	54,693	7,389	47,304
75	49,267	7,574	41,693
76	54,934	8,011	46,923
77	56,539	8,604	47,936
78	60,356	9,605	50,751
79	67,318	9,645	57,674
80	64,462	9,118	55,344
81	58,698	7,844	50,854
82	54,534	7,475	47,059
83	56,694	7,391	49,303
84	54,073	6,933	47,140
85	52,313	6,783	45,530
86	50,920	6,671	44,250
87	53,384	7,080	47,305
88	55,469	7,054	48,415
89	53,852	6,868	46,983

### *The Pro Arguments*

The arguments that supported the consolidation are typically related to the changes in demand which have been presented as the primary catalyst. Arguing in favor of consolidation means accepting the position that what has occurred is the logical economic and market-related response to the disequilibrium that was created when demand for the red meats decreased significantly.

The most forceful argument comes from the "efficiency issue" that is related to economies of size, especially at the packing-processing level. Moving to fewer and larger firms and capturing those economies of size has been positive, especially for the beef sector, runs the argument. Capacity at all levels has been maintained, the herd size has been protected from still deeper cuts, and market share for beef has been supported by the consolidation across the past 10 years.

As suggested earlier, evidence in support of the argument *is* impressive. There is documented evidence of either increased efficiency or lower returns on investment in the packer-processor subsector for beef. By inference, it is not difficult to visualize what would have happened if the farm-retail price spreads had increased directly with overall price inflation. With retail prices capped by consumer resistance, the derived prices at the producer level would have been still lower. Lower cattle prices would have prompted more disinvestment and still deeper cuts in cattle numbers.

Evidence of how important the economies of size can be is presented by Ward (*Meatpacking Competition and Pricing*). For a single-shift plant, Ward estimates the average cost of slaughtering fed steers and heifers at \$29.17 for a plant killing 145 head per hour, at \$22.20 for a plant killing 325 head per hour. At a differential of some \$7.00 per head, the price to feeders for 1,100-pound steers *could* be \$.64 per hundred higher for cattle going into the larger plant.

Additional cost economies accrue from the fabrication phase. For 145 head per hour versus 325 head per hour, Ward's analysis suggests fabrication costs are around \$10 per head lower for the larger plant. The cost saving accruing from the larger plant means producers *could* be paid an added \$.91 per hundred for the 1,100-pound steer moving through the larger operation.

Combined, the differences approximate \$1.50 per hundred between a moderate sized plant (145 head per hour) and a large plant (325 head per hour). The differences would be much more extreme, of course, for a 50 head per hour plant and a 325 head per hour plant, but the evidence is clear: *The large plants can reduce the costs of the slaughter and fabrication functions.*

Across the 1977-87 time period, when much of the consolidation occurred, the price of Choice fed steers at Omaha averaged just over \$60.00. During that same time period, the price of steer feeder calves at Kansas City averaged near \$71. If we assume an average weight for the steer calves

of 450 pounds, the \$16.50 (\$1.50 per hundred times 11 hundredweight) per head potential cost reduction translates to \$3.67 per hundred for the steer calf -- for prevailing costs of corn and other costs of feeding cattle.

The \$3.67 per hundred for steer calves is assuredly a conservative estimate of the efficiencies that could be attached to the consolidation. It is based on the cost savings in a single-plant firm. As Ward notes, there are multi-plant efficiencies within a firm and additional efficiencies and economies in procurement, distribution, and merchandising. The objective here is not one of developing a precise estimate of the magnitude of the cost savings. Rather, it is to develop a logical argument that cost efficiencies *were* realized. The exact level of the efficiencies and the distribution of the benefits to the various levels of the production-marketing systems is a researchable issue that needs and will receive more attention.

Corollary with the consolidation has come new approaches to coordination of the technically related stages of economic activity along the production-marketing continuum in the beef and pork sectors. Contractual procurement, specification buying, and working alliances between packers and feedlots have all become more prevalent. Theoretically, these and related developments have the potential to generate efficiencies in the form of controlled flows of livestock into processing facilities, increased emphasis on production of high cutability livestock, and more stringent quality control in the final cuts of beef and pork. Most research suggests that production-marketing systems that feature management control over activity at the various stages of activity (as in vertically-integrated operations) or close control of quantity and quality flows (as in contractual procurement programs) can provide the final consumer product more efficiently and at lower cost.

The benefits of the more highly coordinated activities were also offered in support of consolidation, and those arguments are still being made. There is validity to the position. Nearly 20 years ago, I advanced the hypothesis that if the price mechanism did not do a better job of coordinating the various interrelated activities in production, processing, and distribution in the livestock sector, the price mechanism would eventually be replaced via integrated or other closely controlled organizational structures. During the 1970s and 1980s, there was no significant move to pricing slaughter cattle or slaughter hogs on a carcass or final-value basis. Yield grades for cattle have been in position since the 1970s, but it was the mid 1980s before any evidence of a premium for Yield 2 cattle was being publicly reported. Several industry-wide attempts to move to cutability based pricing of slaughter hogs have been launched and then abandoned.

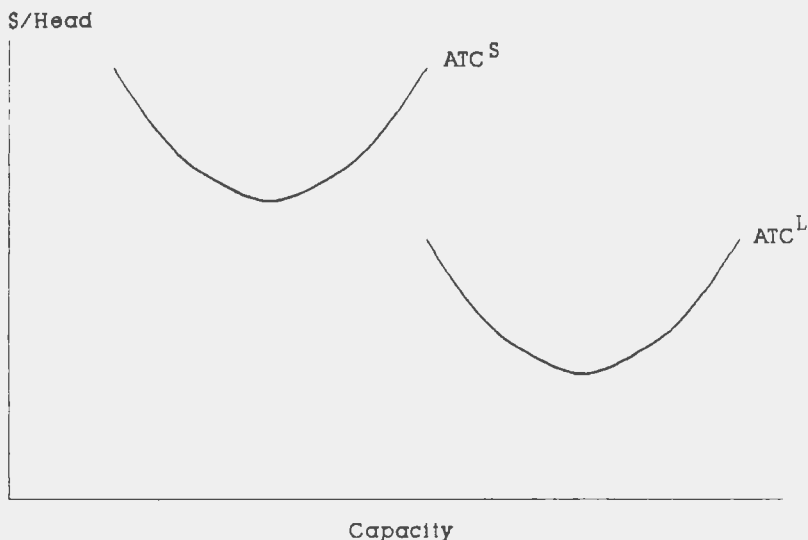
If buying firms face variable flows of livestock in terms of both quantity and quality, there is a powerful economic incentive to reduce or eliminate that variability. *Owning the livestock, having them produced under contract, and moving to specification buying are all largely predictable responses to variability in supplies of slaughter livestock.* During periods the consumer is unwilling to pay higher prices, none of the economic costs of exposure to uncertainty and variability can be passed on to the consuming public. During the period from the late 1970s to the mid to late 1980s when demand problems were acute, the urgency of gaining control over variable raw material supplies and reducing exposure to the risk associated with that variability was surely accentuated. The consolidation and moves to large size provided the economies of scale and size. The moves to gain control over and coordinate the various stages of activity provided, it can be argued, the gains associated with stabilizing and coordinating interlevel raw material and product flows.

Figure 9 provides a graphical exposition of what has occurred and is occurring. In moving from  $ATC^S$  (average total cost for a small plant) to  $ATC^L$  (average total cost for a large plant), the consolidated operations positioned themselves to reap the important economies of size. In the extreme comparisons, the difference between *minimum* points on  $ATC^S$  and  $ATC^L$  may be \$50 per head or more for the combined slaughter-processing functions. Clearly, the capturing of efficiencies that even approach this level provides powerful support to the argument in support of consolidation as a natural economic occurrence, reinforced and stimulated in this case by decreases in demand for beef and for pork. But the change in the *level* of costs is not the only implication of the consolidation.

The  $ATC^L$  function is U-shaped and in this era of specialization, the sides of the curve will be steep. In other words, the kill floor and the fabricating line are designed as *specialized* operations, and are not characterized by high degrees of flexibility in adjusting to varying rates of operation.

Ward (*Meatpacking Competition and Pricing*) estimated the cost of slaughtering cattle in the \$20-25 per head range for large plants. The cost of fabricating in comparable sized plants was estimated in the \$40-45 range. For purposes of illustration, \$22.50 and \$42.50 will be used as representative costs of the slaughtering and fabricating functions. If the hourly operating rate of the kill line and fabricating line were dropped to 80 percent of the designed capacity, *Ward's models indicate per-head slaughtering costs would increase by \$4.77 and per-head fabricating costs would increase by \$3.16 per head.* Combined costs would go up \$7.93 per

Figure 9. Illustration of the Cost Implications of Plants of Different Sizes



head -- a 12.2 percent increase from the combined \$65.00 costs at the designed capacity.

There were and are issues of "economies", issues of efficiency and cost reductions such as those discussed here, involved in the consolidation and the moves to high levels of concentration in the beef sector. The "economies" of the proposed mergers and acquisitions of the 1980s were a factor in the deliberations by the Justice Department and other public agencies. The American Bar Association established a task force to examine the antitrust legislation and enforcement. The Task Force released a report in July of 1989.<sup>2</sup> The importance of the potential economic benefits of economies of size in the rulings of Justice and in the "merger guidelines" developed by the Justice Department in 1984 is clearly documented by the Task Force report.

<sup>2</sup> American Bar Association, *Report of the American Bar Association Section of Antitrust Law Task Force on the Antitrust Division of the U.S. Department of Justice*, New York, July 1989.

There are powerful economic arguments in support of benefits to the consolidation in the beef sector. Economies of size have been captured, and related changes in procedure (contracting, integrated operations) have the potential to generate even more savings. More refined estimates of the benefits are needed, but the failure of farm-retail price spreads for beef to increase with overall price inflation provides powerful evidence that the benefits were present. The beef cattle industry is larger and retains a larger market share as we move into the 1990s than would have been the case had the consolidation not occurred.

Earlier in the chapter, I suggested the issue in its simplest form was "efficiency versus market power". Moving into the decade of the 1990s, the 4-firm concentration ratio in boxed beef activity is around 80. For fed steers and heifer slaughter, the 4-firm ratio is apparently now above 70. In pork, the consolidation has not reached comparable levels, but the 4 largest firms are killing around 40 percent of the slaughter hogs. In sheep and lambs, the current 4-firm concentration ratio is estimated, using Packers and Stockyards Administration data, to be near 80. It can be forcefully argued that increased efficiency has accompanied the consolidation, but there is another side to the issue.

Market power accompanies moves to large firm size and high levels of concentration. The so-called structure-conduct-performance model of industry behavior infers a causal flow from structure to firm conduct to measures of industry performance. Conceptually, high levels of concentration (structure) lead to predictable types of firm behavior (conduct) which in turn leads to predictable developments in price and pricing, profit margins, etc. (performance).<sup>3</sup> Much of the thrust of the "con" side of the observed consolidation will come from the argument that high levels of concentration will lead to undesirable industry performance. In particular, there will be concern as to whether any benefits of large size get passed on to producers or consumers, or whether they are simply retained by the large firms in a consolidated industry.

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<sup>3</sup> The ERS report by Marion and Handy is a 1973 publication, but remains a useful description of the structure-conduct-performance model. Bruce R. Marion and Charles R. Handy, *Market Performance: Concepts and Measures*, Agricultural Economics Report No. 224, Economic Research Service, U.S. Department of Agriculture, September 1973.

## *The Con Arguments*

The concerns about the performance of a highly concentrated industry are not new. The most recent surge in attention occurred in the 1979-80 period. Retail beef prices increased rapidly as the cattle industry moved into what was to be a short-lived expansion phase. In nominal terms, the price of retail Choice beef increased from \$1.82 in 1977 to \$2.26 in 1979, and the inflation-adjusted prices (CPI, 1982-84=100) increased from \$2.45 to \$3.12, a 27 percent increase.

Virtually all of the 27 percent increase in inflation-adjusted prices could be explained by the corollary 15 percent decrease in per capita supplies. Per capita consumption in retail weight equivalent dropped from 91.4 pounds in 1977 to 78.0 pounds in 1979 as the industry moved from herd liquidation in 1977 to herd expansion during 1979. But the price increases in beef came in the presence of increasing levels of concentration in the beef sector and in the presence of declining inflation-adjusted prices for pork. Inflation-adjusted prices in pork declined from \$2.07 in 1977 to \$1.99 in 1979 as per capita supplies and per capita consumption increased from 55.8 pounds in 1977 to 63.7 pounds in 1979.

The contrasting price patterns received a great deal of attention, and the early signs of increasing levels of concentration in the beef sector were presented as a possible causal factor. Various pieces of legislation designed to constrain the size and/or market share of individual firms were introduced, and public hearings were held by congressional committees in the House of Representatives.<sup>4</sup>

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<sup>4</sup> House of Representatives bill H.R. 5733 was one of the more widely discussed pieces of proposed legislation. Entitled the *Meat Industry Act to Preserve Competition*, its stated purpose was to "restore, preserve, and promote competition in the meat industry and to protect small businesses against the growth and use of monopoly power and unfair trade practices of major meat companies." Meatpackers would have been prohibited, for example, from slaughtering more than 25 percent of the national production of various classes of livestock (steers and heifers, cows and bulls, hogs) or from controlling more than 25 percent of the boxed beef or centrally cut beef market.

H.R. 7197, entitled the *Small Business Preservation and Protection Act of 1980* was introduced to "assist and protect small businesses against unreasonable use of economic power by major meatpacking companies." Provisions would have prevented firms from slaughtering more than 25 percent of the national supply of steers and heifers, for example, and would have blocked acts of selling below cost for the purpose of impairing the marketing ability of small meatpacking concerns. This bill also included language prohibiting the officials of large meatpacking concerns from buying and selling livestock futures contracts and prohibiting large meatpackers from speculating in livestock futures contracts.



Table 8 records the percent of U.S. slaughter by the four largest firms by livestock category from 1970 to 1978. There are no visible indications that the percentage of slaughter by the four largest firms was increasing significantly during the 1970s. Only the sheep and lamb slaughter category showed a 4-firm concentration ratio above 50. The composition of the four largest firms changed during the period for most classes of livestock shown in the table.

The evidence presented during the discussion of H.R. bills 5733 and 7197 tended to deny the existence and exercise of oligopolistic or oligopsonistic power by the large meatpacking firms. A study by Multrop and Helmuth<sup>5</sup> for the House Small Business Committee reported that increased concentration in steer and heifer slaughter had increased the price of fresh beef. The study was widely criticized on methodological grounds, however, and apparently was not extended a high level of credibility.

A U.S. Department of Agriculture Study by Connor<sup>6</sup> was widely quoted and concluded there was no evidence of monopoly power in the meatpacking industry. Schnittker Associates<sup>7</sup> suggested that no empirical link between levels of concentration and performance in the meatpacking industry had been presented. They argued that much of the evidence in support of concerns about increased concentration was strictly theoretical in nature. Excerpts from testimony during public hearings were employed in the Schnittker publication to support their claim that no empirical link between structure (as measured by concentration ratios) and performance (price levels, profit margins, etc.) had been established.

Gisser<sup>8</sup> examined data for 1963-72 for U.S. food manufacturing. He concluded that the benefits of increased factor productivity (economies of size) from the larger firms in more concentrated industries were sufficient to offset any losses to consumers. Gisser's study concluded that the anti-trust agencies should not disturb the food manufacturing industry, that

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<sup>5</sup> John R. Multrop and John W. Helmuth, *Relationship Between Structure and Performance in the Steer and Heifer Slaughtering Industry*, Committee on Small Business, U.S. House of Representatives, September 1980.

<sup>6</sup> John M. Connor, *The U.S. Food and Tobacco Manufacturing Industries: Market Structure, Structural Change, and Economic Performance*, Agricultural Economics Report No. 451, ESCS, USDA, March 1980.

<sup>7</sup> Schnittker Associates, *An Economic Analysis of the Structure of the U.S. Meat Packing Industry*, Washington, D.C., Number 11, 1980.

<sup>8</sup> Micha Gisser, *Welfare Implications of Oligopoly in U.S. Food Manufacturing*, American Journal of Agricultural Economics, November, 1982, pp. 616-624.

Table 8. Percent of U.S. Slaughter by the Top Four Meatpacking Firms, 1970-78

Year	Cattle	Steers and Heifers	Hogs	Sheep and Lambs
(Percent)				
1970	21.3	27.3	31.5	53.1
1971	21.4	27.8	31.8	53.2
1972	22.3	28.8	31.6	54.7
1973	22.8	30.6	32.9	51.8
1974	20.9	28.7	32.7	55.7
1975	19.3	28.1	33.1	57.5
1976	19.6	27.5	32.3	53.6
1977	20.2	29.1	32.6	52.9
1978	22.9	21.7	34.4	56.4

SOURCE: Packers and Stockyards Administration, Agricultural Marketing Service, U.S. Department of Agriculture.

any efforts toward forced restructuring might deprive consumers of the apparent benefits of concentration and large firm size.

Ward<sup>9</sup> examined price data at the feedlot level for localized geographical markets. In identified market areas, Ward found the market share of the largest buyer ranged up to 48 percent, and the market share of the four largest buying meatpackers ranged up to 100 percent within the market areas. Recognizing that the study of local markets might need to be expanded in terms of time, sample size, and areas studied, Ward found no evidence that larger beefpackers paid lower prices for fed cattle.

<sup>9</sup> Clement Ward, *Relationship Between Fed Cattle Market Shares and Prices Paid by Beefpackers in Localized Markets*, Western Journal of Agricultural Economics, July 1982, pp. 79-86.

Menkhaus, St. Clair, and Ahmaddaud<sup>10</sup> employed state-level concentration measures for two years, 1972 and 1977, and analyzed the relationship between concentration measures and the price of Choice fed steers. They found a statistically significant and negative relationship for both study years, indicating that fed cattle prices were lower in the more highly concentrated market areas. The use of state data could be and has been criticized since packers buy cattle across state lines. A more useful definition of the "market area" would cut across state boundaries, but data are not readily available to facilitate analysis with a geographical definition of market areas that crosses state boundaries.

The discussions and dialogue of the 1979-80 period tended to suggest that the then-prevailing levels of concentration were too low to cause concern. The effort by Schnittker Associates, for example, excerpted the historical literature on concentration ratios and documented levels of concentration that have been presented as "threshold" levels, those levels at which the problems associated with large size and market power would develop. Since the concentration levels in the late 1970s were below many of those thresholds, the implicit argument was that there was no reason to be concerned.

But the concentration ratios have changed significantly since the 1970s. Table 9 starts with final data for 1978 and extends the measures presented earlier in Table 8 through 1988. The concentration ratio for boxed beef is also added to the table. The 4-firm concentration ratio has more than doubled since 1978 for all cattle and for fed steers and heifers. Hogs show little increase, but sheep and lambs show a 4-firm concentration ratio above 70. The 4-firm concentration ratio for boxed beef moves from 59 in 1978 to 79 in 1988, and much of the increase came with the last "round" of acquisitions in the mid 1980s.

The situation is vastly different as we move into the 1990s than it was in the late 1970s. Schnittker Associates, in their 1980 publication, used the following from Scherer:<sup>11</sup>

When the leading four firms control 40 percent or more of the total market, it is fair to assume that oligopoly is beginning to rear its head.

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<sup>10</sup> Dale J. Menkhaus, J. St. Clair, and A. Ahmaddaud, *The Effects of Industry Structure on Price: A Case in the Beef Industry*, Western Journal of Agricultural Economics, December, 1981, pp. 147-153.

<sup>11</sup> F. M. Scherer, *Industrial Market Structure and Economic Performance*, Rand McNally and Company, Chicago, 1970, p. 60.

Table 9. Percent of U.S. Slaughter or Activity by the Top Four MeatPacking Firms, 1978-88

Year	Cattle	Steers and Heifers	Hogs	Sheep and Lambs	Boxed Beef
(Percent)					
1978	24	30	34	56	50
1979	29	35	34	64	51
1980	28	36	34	56	53
1981	31	40	33	52	57
1982	32	41	36	44	59
1983	36	47	29	44	60
1984	37	50	35	49	62
1985	39	50	32	51	62
1986	42	55	33	54	68
1987	53	67	37	75	80
1988	57	70	34	77	79

SOURCE: Packers and Stockyards Administration, Agricultural Marketing Service, U.S. Department of Agriculture.

The authors also used the following excerpt from Kaysen and Turner:<sup>12</sup>

Within the general classification of structural oligopoly, we make a distinction between two sub-classes. In what we call Type One structural oligopoly, the first eight firms have at least 50 percent of total market sales, and the first twenty firms have at least 75 percent of total market sales. In Type One oligopoly, recognition of interdependency by the leading firm is extremely likely... Type Two oligopoly is defined by a market share of 33 percent for the eight largest sellers ...

<sup>12</sup> Carl Kaysen and Donald F. Turner, *Antitrust Policy*, Harvard University Press, Cambridge, Massachusetts, 1959, p. 27.

It is clear that the traditional thresholds offered by Scherer and by Kayson and Turner are now far exceeded in the cattle, fed steers and heifer slaughter, sheep and lamb, and boxed beef categories. But the central issue is still very much present: *Has an empirical link between concentration and performance been demonstrated on either the buying side or selling side in the now highly concentrated meat industry?*

Analyses of the relationship between consolidation and selected measures of performance, since the beef sector has consolidated so dramatically, are few in number. A 1989 paper by Azzam and Pagoulatos<sup>13</sup> examined the entire meatpacking sector, but the data period was 1959 through 1982. Specifying a model that allowed the estimation of the degree of market power on both the procurement and selling sides, the authors concluded that market power was present in both activities. They had hypothesized any evidence of market power in the more localized procurement markets would be greater than in the more nearly national selling market. The results supported their hypothesis. There is no apparent attempt in the paper to measure the implications of market power so as to compare them to any possible benefits accruing from the economies of size in large firms.

Schroeter<sup>14</sup> conducted an analysis of the beef sector using data through 1983 with an objective of identifying the existence of any market power. He found evidence of non-competitive (monopoly/monopsony) behavior that was statistically significant, but of small magnitude. He concluded there was no evidence of appreciable worsening of the markets' performance during the recent (prior to 1983) period of increasing concentration.

Koontz, Hudson, and Garcia<sup>15</sup> used a game theory approach in a 1989 report to investigate the behavior of meatpacking firms in four geographic markets. The market areas included multiple states in some instances, and were selected based on areas in which the USDA reports trade and price information for cattle that move direct to packing plants. The authors hypothesized that cooperative behavior would tend to be present when few firms were available to bid on cattle. They also hypothesized that periods would exist, such as when the supply of slaughter-ready cattle

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<sup>13</sup> Azzeddine Azzam and E. Pagoulatos, *Testing for Oligopoly and Oligoposony Power*, WP-15, NE-165 Project, September 1989.

<sup>14</sup> Schroeter, John R., "Estimating the Degree of Market Power in the Beef Packing Industry", *The Review of Economics and Statistics*, Vol. 70, No. 1, 1988, pp. 158-162.

<sup>15</sup> Stephen R. Koontz, M. Hudson, P. Garcia, *Oligopsony Power, Meatpacker Conduct, and Price Dynamics: A Preliminary Investigation of the Live Cattle Markets*, NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management, Chicago, April 20-21, 1989.

was unusually small, that the cooperative behavior would be abandoned as one or more firms bid aggressively for the available cattle.

In selecting periods when the cost and demand parameters were stable, Koontz et. al. selected the sub-periods June 1980-June 1982 and June 1984-June 1986 for analysis. Weekly prices were employed. The authors concluded that (1) evidence of cooperative behavior was present in some of the regions, (2) there was a tendency for the cooperative behavior to be present in the areas with the smallest number of buying packers, and (3) there was a tendency for more cooperative behavior to be present in the later (June 1984-June 1986) time period. The authors concluded the documented behavior suggests the potential is present for increased oligopsony returns to the buying packers and lower relative prices for producer cattle.

John Connor prepared a "working paper" designed to be a chapter in a report commissioned by the National Cattleman Association's Concentration/Integration Task Force.<sup>16</sup> Connor traces through the conceptual issues involved in using concentration measures, and discusses related issues in market definition and model specification. He documents the rapid increase in 4-firm concentration ratios during the 1980s in beefpacking and processing operations, and points to the existing excess capacity in beefpacking as an impediment to the entry of new firms. Connor discusses the countervailing power that exists when representatives of beefpackers seek to sell meat to large wholesalers and/or retail chains. He notes, however, that "... if beefpacker seller concentration were to rise much further above present levels, the countervailing power of wholesales will count for little." (Working Paper 16, p. 30).

Ward,<sup>17</sup> in a study accepted for 1990 publication, documented the existence of excess capacity as suggested by Connor. He found that the larger packing and processing operations operated at higher levels of capacity and could, theoretically, pay higher prices for cattle. But the author suggests the higher price *will* be paid only if significant competition among meatpackers exists.

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<sup>16</sup> John Connor, *Concentration Issues in the U.S. Beef Subsector* in "Competitive Issues in the Beef Sector: Can Beef Compete in the 1990s?" to be released by the Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, Minneapolis, September 1989. The author's efforts were available initially as WP-16, Agricultural Economics, Purdue University.

<sup>17</sup> Ward, Clement E., "Meatpacking Plant Capacity and Utilization: Implications for Competition and Pricing," *Agribusiness: An International Journal*, forthcoming in 1990.

Connor discusses the possible use of excess capacity as a means of blocking entry of new firms, and indicates current research data suggests neither economies of scale nor multiplant economies are sufficient to justify current levels of concentration in beefpacking. He indicates that four firms, with a single optimal sized box-beef plant, would result in a 4-firm concentration ratio of at most 16 percent. Connor concludes that economies of scale and multiplant economies can account for at most half of the increase in beefpacker concentration observed since the mid 1970s.

Connor reviews several studies of concentration in the 1970s and concludes the likely average impact of buying power by beefpackers was to raise retail prices by 0.3 to 0.6 percent. He also makes reference to the review by Ward (*Meatpacking Competition and Pricing*) that reviewed nine studies that found buyer concentration was inversely related to the prices of hogs and slaughter lambs. Connor also discusses the reductions in farm-retail price spreads during the 1980s that were documented earlier in this chapter. He estimates that across the 1974-85 period, beefpackers profits were around 16 percent when measured as returns to invested capital (stockholder's equity). He notes that profits at the 16 percent level would be comparable to profits for other food processors during the period, but would be higher than the rest of manufacturing.

Overall, Conner reports no evidence of a strong and highly significant link between concentration and performance in beefpacking. He portrays a concern about what is happening, however. At one point, he notes:

It is difficult to believe that the higher levels of concentration and barriers to entry seen today (levels considerably higher than the buyer concentration of meat distributors) would not cause some price elevation (Connor, 1989, p. 44).

It is important to recognize that the "price elevation" Connor refers to is relative to what beef prices would be in perfectly competitive markets, not necessarily price increases in beef over time.

The debate, dialogue, and concern about possible negative implications of consolidation and high levels of concentration will continue. Congress is widely expected to hold public hearings in 1990. There appears to be a broad base of interest and concern, especially at the producer level. In late 1987, the American Farm Bureau solicited the assistance of the Agricultural Cooperative Service of the USDA in a broad survey of Bureau

members who were livestock producers. The survey<sup>18</sup> has been widely distributed, and documents widespread interest and concern about changes in the industry.

Respondents to the survey were asked to compare the years 1982 and 1987. A battery of questions was employed and the survey was designed to generate information on access to markets, perceptions of the level of competition in the marketplace, concerns, number of buyers bidding on livestock, etc. In general, the survey results document a reduction in the number of bids and an often significant concern about the level of competition, and the overall situation was perceived to have deteriorated significantly from 1982 to 1987.

Table 10 is adapted from the Hogeland report, and is included to illustrate the type of information that was accumulated. The results shown are for Quarter 6 of the survey which reads as follows:

For livestock sold direct to a packer or dealer, how many price quotations or bids did you normally receive for your animals in 1982 compared to the present?

Table 10 documents clear reductions in the number of bids for all classes of livestock shown. This holds true for slaughter hogs as well where the level of concentration at the national level has not moved to the levels currently observed in the cattle and sheep markets.

The important questions remain, however. *Is a reduction in the number of bids sufficient to conclude that market power is being employed to the detriment of livestock producers -- or to any other group?* Do a limited number of firms compete just as aggressively for livestock? Some researchers have found a positive relationship between number of buyers and prices for livestock at auctions, but does this result hold for direct buying of livestock? Is there a significant difference in the performance between highly concentrated markets at the national level and highly concentrated markets at the regional or local level?

Limited evidence is starting to appear. The Koontz-Hudson-Garcia effort focused on recent developments in fed cattle markets. In my own examination of developments in the southeastern hog market, changes appear to be occurring in both spatial prices and in the variability of intermarket

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<sup>18</sup> Julie A. Hogeland, *Market Access in an Era of Structural Change in the Livestock Industry*, Agricultural Cooperative Service, U.S. Department of Agriculture, September 26, 1988.



Table 10. Responses on Number of Bids for Selected Classes of Livestock, 1982 and 1987, American Farm Bureau Survey

No. Bids	Feedlot Cattle			Slaughter Hogs			Slaughter Lambs		
	1982	1987	Percent Change	1982	1987	Percent Change	1982	1987	Percent Change
One	86	141	+64	150	207	+38	66	92	+39
Two	185	269	+45	256	300	+17	49	43	+8
Three	171	121	-29	140	104	-26	21	13	-24
Four	78	34	-56	59	35	-41	22	14	-48
Five	31	10	-68	17	6	-65			
Six or More	29	4	-86	13	8	-38			
Total Respondents	580	579		635	660		157	159	

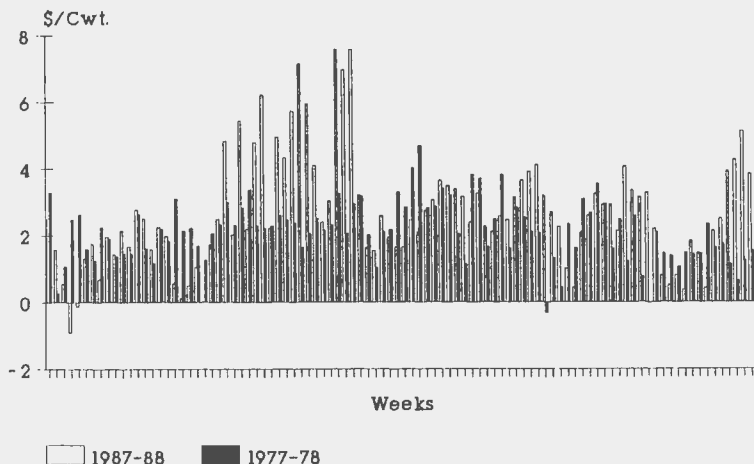
SOURCE: Adapted from Julie A. Hogeland, *Market Access in an Era of Structural Change in the Livestock Industry*, Ag. Coop. Service, U.S. Department of Agriculture, September 1988.

price differences. Smithfield Packing, located in Smithfield, Virginia, is one of the top five national hog slaughterers and buys hogs throughout the Southeast. From 1979 through late 1989, the difference between monthly hog prices for Omaha and the southeastern Virginia markets (the Smithfield area) shows a statistically significant positive trend. With the difference defined as Omaha minus southeastern Virginia, this result suggests Omaha prices are increasing relative to southeast Virginia.

If differences in weekly hog prices for Indianapolis and southeastern Virginia are analyzed, the differences are larger and much more variable in 1987-88 than they were in 1977-78. Figure 10 shows a bar chart for the two periods, with Indianapolis ranging up to \$8 per hundred above Virginia prices in 1987. The standard deviation of the differences in 1987-88 was 1.9 times the standard deviation in 1977-78. It appears the sharp changes in 1987 were related to the closing of a Swift plant in Georgia. The price comparisons suggest the sensitivity of prices to changes in the limited number of packers in the entire region.

The Virginia area and the southeastern states in general are deficit producing states relative to Smithfield's slaughter capacity. In recent years, Carroll Foods of Virginia (a production affiliate) has embarked on a program to put in 50,000 sows and finish the hogs in company-owned facilities. During the 1980s, several small to moderate sized slaughter

**Figure 10. Indianapolis Cash Minus  
Southeast Virginia Cash Hog Prices,  
Weekly, 1977-78 and 1987-88**



firms in the area from Virginia south to Georgia and Alabama have gone out of business, and the inter-regional price comparisons appear to show significant impact from those closings.

Are the spatial price patterns discussed here suggestive of what can happen in an area where (1) the concentration ratio is high and one firm dominates procurement, and (2) the dominant firm moves to integrated production programs? Producers in the Smithfield buying area indicate they feel they are, at best, residual suppliers. Even cooperative producer programs, where hogs are commingled and sorted into uniform lots, appear to be facing the same situation. Their hogs are in demand and bids are viewed as "competitive" when company-owned hogs are not abundantly available in slaughter-ready status. But when the packer-owned primary hogs are sufficient to meet the bulk of the kill needs, the producer-group hogs are not aggressively sought. Brief surveys suggest producers feel this is the reason for the increasingly variable relationship between their local cash market and eastern Corn Belt terminal markets such as Indianapolis.

There is no suggestion here that what appears to be happening in the Southeast in hogs will necessarily be duplicated in other areas or that the possible application of market power will be extended to other areas and to other classes of livestock. What *is* being suggested, however, is that the potentially negative ramifications of consolidating markets and related changes in vertical market relationships may still be in the future. What has happened in the Southeast hog market may be indicative of what could happen in other areas and for other classes of livestock in the future.

Large firms are driven by the need for large volumes. When livestock numbers are tight relative to kill needs and industry capacity, as is the case now in the slaughter cattle market, the need for volume may provide a "safety net" of protection against the exercise of market power. But the safety net may be rendered less than adequate if corollary changes in industry operation develop. In southeastern Virginia, for example, Carroll Foods of Virginia publicly announced plans to place 50,000 sows in production could eliminate any "safety net" feature. The output from a company controlled program of that magnitude would approach 25 percent of the company's annual slaughter volume and captive supplies of that magnitude significantly ease worries about supplies of slaughter hogs.

In the fed cattle sector, a great deal of attention is being paid to "captive supplies" of cattle -- cattle fed by or for packers, and cattle fed under contract or in feedlots with a specific working arrangement with the packer. Where and how the cattle are fed, of course, does not change in the short run the total supply of feeder cattle. Longer term, the breeding herd in hogs, cattle, or in sheep could be influenced by such activities of the large firms. But in the short and intermediate time spans, the relatively tight supplies of cattle, slaughter lambs, and possibly even hogs may in fact defuse any efforts by a consolidated industry to use market power to the advantage of the now fewer and larger firms.

In sum, it is easier to find documentation in the current research literature of the "pros" of consolidation than it is the "cons" that relate to the market power issue. If this is the correct assessment, it is a strong argument for more research to investigate the implications of the structural changes in the livestock sector. Chapter 2 will provide the results of research focusing on implications to pricing and competition in the cattle feeder/packer subsector. Chapter 3 will report on a parallel research effort focusing on the packer/retailer subsector. The following sections of this chapter deal with the continuing issues that appear to demand attention as we move into the 1990s.

## *Issues for the 1990s*

The implications of the unprecedented consolidation in the livestock sector will dominate the agenda for the early 1990s. There will be calls for more research, and research will be needed to answer questions that cannot be answered at present. Legislation will be proposed to constrain, perhaps reverse, the structural changes which have occurred. Federal regulatory agencies, the Department of Justice, Packers and Stockyards Administration, and the Federal Trade Commission will be called on to clarify their positions and re-examine their policies and positions on the allowing of acquisitions and mergers. In the presence of the vertically integrated activities and contractual arrangements that have accompanied the structural change, there will be increased concern voiced over access to prices and related market activity. The issues surrounding required reporting of prices and/or volume of livestock being acquired by internal transfer or contractual arrangements are sure to be raised and discussed.

A central theme of all the discussions will be the implications to pricing and competition at the producer level. Individual producers are typically too small to influence price or other terms of trade, and the need for legislative, legal, or policy action to protect producers' positions will be discussed. Producers will consider various types of collective or group actions to generate some type of "countervailing power" in dealing with large and powerful livestock buyers. At every turn, there will be interest in what alternatives are available to producers and producer groups.

The research reported in this and succeeding chapters will contribute to the needed base of information. Presentations and discussions during the national conference for which this book is being prepared will deal with the issues. The legal and legislative perspectives will be explored, and the implications of what has occurred to the price discovery process and to the reporting of market activity will be raised and discussed by representatives of the private and public sectors. But many questions remain unanswered and many issues have not been explored. There is a need to move toward the establishing of a research agenda and, based on a solid base of information, to move toward an industry-wide plan that helps to insure the economic viability of the sector and to recognize the position and needs of industry participants at every level.

## *A Research Agenda*

Conceptually, there are benefits to consolidation. The economies of size in large plants and potential multi-plant economies have been widely discussed. Earlier in this chapter, I suggested that the massive consolidation in the beef sector during the 1980s was, perhaps, an inevitable result of the economic pressures coming from declining demand for beef. It was suggested that the economies of size have saved industry capacity at all levels by tempering the downward pressure on prices at the producer level. Conceptually, large and well financed firms would be in a position to generate additional benefits via the adoption of technologies that smaller firms might find inapplicable or beyond their financial capacity.

The magnitude and distribution of the benefits from cost-reducing technology is an important researchable issue. Attitudes toward consolidation will clearly be a function of the level of any benefits and how they are distributed among various industry groups. The 1988 article by Mullen, Wohlgenant, and Farris<sup>19</sup> is an example of the type of research that is needed. The authors examine the potential savings from moving beyond boxed beef to tray-ready beef. They find the distribution of any "surplus" from the cost-reducing technology is highly dependent on the level and nature of the substitution allowed between farm and non-farm inputs such as value-added further processing. The authors estimate that producers receive 57 to 72 percent of the surplus, depending on what assumption is made about input substitution. They note that more attention should be paid to reliably estimating the elasticity of substitution parameter since it exerts a major influence on how the benefits of cost-reducing technology will be distributed.

**Research is needed to estimate the magnitude of any benefits accruing from economies of size and how those benefits are likely to be distributed across industry participants. The work should be extended to include any cost-reducing technologies that can reasonably be associated with large-size firms and/or the possibilities of multi-plant economies in procurement, processing, merchandising, and distribution.**

Economies of size and the adopting of new technology has an influence on the *level* of the costs of doing business. Earlier in the chapter, the importance of the *nature* and *shape* of the cost curves was introduced. Reference was made to research by Ward (*Meatpacking Competition and*

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<sup>19</sup> John D. Mullen, M. Wohlgenant, and D. Farris, *Input Substitution and the Distribution of Surplus Gains from Lower U.S. Beef-Processing Costs*, American Journal of Agricultural Economics, May 1988, pp 245-254.

*Pricing*) that indicated the importance of operating at or near the designed optimum capacity of the plant or multi-plant firm operation.

With the consolidation has come new ways of doing business. The large meatpacking firms are moving aggressively to gain a higher degree of control over the flow of livestock into their plants in terms of both quantity and quality. Part of this control is being accomplished by integrating vertically through ownership of cattle, hogs, and lambs in feeding programs. But control is possible via other ways of coordinating activity. Formal arrangements between feeding programs and packers and contractual procurement allow the buying packer to schedule a flow of livestock into their kill program and to specify quality specifications in a more visible way.

A consistent flow of livestock has the potential to reduce average costs of killing, fabricating, and distributing the finished product. The increased per head costs associated with operating at levels below or, occasionally, above designed capacity because of variable flows of slaughter livestock can be partly offset by gaining control over and stabilizing livestock flows. In the short run, the existing industry capacity can be operated more efficiently and at lower per unit costs. In the long run, plants and fabricating lines can be designed to realize higher levels of efficiency if the quantity flow of livestock is stabilized by various means of coordinating the technically related stages of activity. Also, in the long run, closer control over quality has the potential to better align what is being offered with what consumers want and to enhance the competitive position of the industry in the consumer markets.

The extent to which vertically coordinated activity under the emerging modes of operation is more efficient than total reliance on buying day-to-day in the live animal market is an issue that needs more investigation. Historically, the research literature generally supports an hypothesis that vertically integrated systems can be operated more efficiently and at lower costs than systems that rely totally on open market transactions and on the price mechanism and price signals to prompt needed changes. Observers point to the poultry sector and its integrated structures as an example, and there have been suggestions for some time that the beef, pork, and sheep sectors will move in the same direction. If current trends toward closer control of the producing, slaughtering, and fabricating functions continue, these trends and the related decisions to push toward control need to be based on sound information. In particular, we need research to estimate the magnitude of any benefits from the emerging op-

erational procedures, how any benefits are distributed, and the implications to the long-range growth and viability of the livestock sectors.

**Research is needed to estimate any benefits of the emerging systems of integrated and contractual activity. If cost savings and efficiencies are present, information on how those benefits will be distributed is needed. It will be important to include possible implications to the long-range viability of the industry if it stresses management and contractual control as opposed to reliance on open-market transactions and the coordinative functions of the open-market pricing mechanism.**

With contractual procurement, integrated programs, and related systems of operation comes concerns about the impact on price levels, price variability, and the overall level of buyer competition at the producer level. There is a tendency to suggest that when a buying packer is "out of the market" during a week because they are killing previously contracted livestock, the demand for fed cattle, hogs, or slaughter lambs is reduced accordingly and prices will be lower. That argument is countered by the observation that the contracted livestock are also removed from the available supply for the week, and the impact on price is neutral. In addition, it is suggested, the livestock were bought and priced at an earlier date or provisions were included in the contract as to when and how the livestock will be priced. Some observers then argue that there is no significant impact on price.

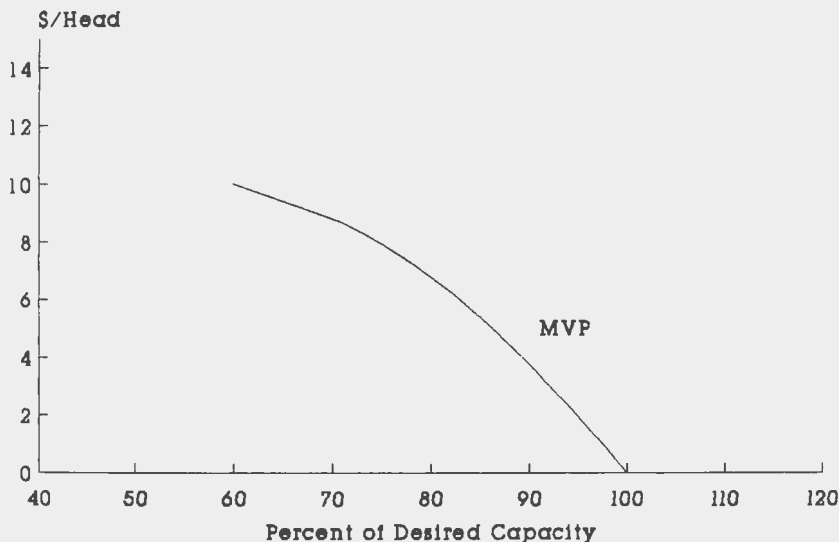
Implications of contractual procurement and related changes at the feeder/packer interface will be the focus of attention in Chapter 2. Clement Ward reports on research designed specifically to look at the incidence of contracting, daily pricing activity at the feedlot level, and how it is changing in a changed cattle industry. But it is productive to look at the conceptual motivations behind the obvious desire to schedule the availability of livestock at the packer level.

Earlier, evidence of the importance of operating at or near designed or desired levels was presented. Conceptually, there is an implicit demand for livestock that is capacity related, and is largely independent of the current and developing outlook in the final product market. Figure 11 demonstrates, relating the capacity-related value of an added head of livestock (vertical axis) to the operating level expressed as a percent of the designed or desired level (horizontal axis).<sup>20</sup>

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<sup>20</sup> There is no suggestion here that the designed level will be at the minimum point of the U-shaped Average Total Cost curve. That result would be appropriate if the industry were purely competitive. But meatpackers face a demand curve with some slope given their efforts to differentiate their product, distribution, service, etc. in beef, pork, or lamb. The *desired* level from the

**Figure 11. The Relationship Between  
Value Per Head of Livestock and  
Operating Level as a Percent of Optimal**



The curve shown is identified as an MVP curve, or the marginal value product per head at varying levels of operating capacity *coming only from changes in operating level*. Its shape will be in a mirror-image relationship with the shape of the ATC curve to the left of minimum ATC (refer to Figure 9). Since the ATC curve in that position is convex to the origin, the MVP of livestock to move up toward the optimal operating level will be concave to the origin. The value of an added head of livestock decreases at an increasing rate as the optimal level is approached.

At 50-60 percent of the desired operating level, the MVP per head can be relatively large. Recall that Ward's estimates were for \$4.77 per head in-

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firm's viewpoint is, therefore, the profit maximizing level which is conceptually determined by marginal analysis and it will be a volume smaller than that associated with the minimum point on the ATC curve. Whether this is the *desired* level from society's viewpoint depends, of course, on the trade-offs between the efficiencies of economies of size and the price/profit possibilities associated with market power accruing to large firms in highly concentrated markets.



creases in slaughtering costs at 80 percent of the desired hourly rate. *Conceptually, it is clear that the packer has a powerful incentive to gain control of the flow of livestock into the plant and to stabilize it at or near desired levels.* The move toward developing captive supplies of cattle, hogs, or sheep is explicit evidence of the strength of that incentive.

The converse reasoning also holds. When the packer does *not* have the captive supplies from which to draw kill needs, they face an almost urgent need to get the necessary supplies bought. If the supplies of market-ready livestock are unusually small for a particular week or even for a particular day, the packers may temporarily abandon their per-head target margins and bid up the prices of available cattle, hogs, or sheep in an attempt to meet kill needs. This could mean \$1.00 per hundred higher bids for cattle, for example, *based strictly on the cost savings related to operating levels and for given selling prices for the finished products.* Such "bidding up" of live animal prices would be consistent with the non-cooperative behavior Koontz, Hudson, and Garcia concluded exists in even highly concentrated market areas when the supply of market-ready cattle is usually tight.

A possible impact on the short-run demand for livestock is shown graphically in Figure 12. On the vertical axis is a reasonable price scale for fed cattle. The horizontal axis shows operating levels as a percent of the optimal or desired level, the level denoted as 100 percent. Consider the positions of two packers. Packer A has 80 percent of cattle needs contracted and scheduled for immediate delivery, and the delivery will occur in a market that had been stable at \$70 during the most recent week. Packer B, on the other hand, has no cattle contracted and must look to the cash market for all its cattle needs. Assume the two packers are of similar size and are similar in overall costs and operating efficiency, and face a rather lengthy haul if they move out of their normal procurement area to bring cattle in from other areas.

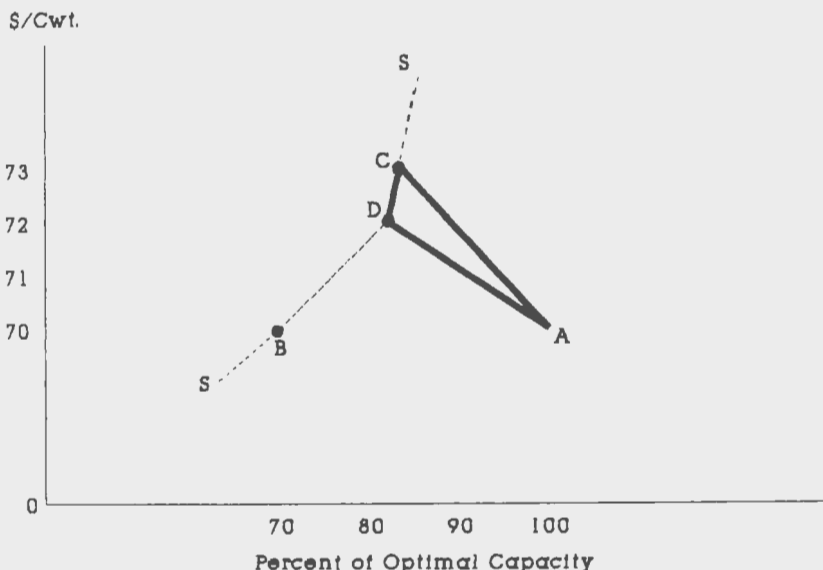
If both packers are seeking to line up immediate kill needs, they will periodically face days in which the available slaughter-ready cattle (including the contracted cattle) would meet only 70 percent of their combined kill needs. The supply curve would be very steep<sup>21</sup> at a quantity comparable to 70 percent of kill needs.

Packer A will have 80 percent of its kill needs, but would be interested in buying more cattle. Given the capacity-related value of moving up to

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<sup>21</sup> The day-to-day supply function for fed cattle will always have some slope because cattle can be pulled a few days early, and feedlots will increase their offerings slightly in response to higher bids. And at substantially higher prices, at least some cattle could be hauled in from other areas.

**Figure 12. Possible Impacts of  
Contractual Procurement on Demand  
for Slaughter Livestock**



desired kill levels, the demand for cattle for Packer A in moving from 80 to 100 percent of the desired operating level would slope down from, perhaps, \$71 to \$70 or the price consistent with the earlier \$70 market. Packer A *would* be willing to pay more for cattle, and the prices would be bid up relative to the recent \$70 market. Keep in mind the added value of more cattle that comes solely from reduced costs as the operating level moves up toward desired levels.

Packer B, with no cattle contracted, faces a more urgent situation. It will be costly in terms of costs per head to operate at 70 percent of desired capacity, and Packer B will bid aggressively in an effort to secure cattle. Based strictly on the MVP associated with declining per head costs that comes from higher operating levels, Packer B could bid up to some significantly higher price, such as \$73, if that higher bid is expected to move numbers from 70 percent up to 80-90 percent of desired operating capacity.

Figure 12 pictures one possible result of competition between the two packers and suggests the possible and logical implications of contracting on the short-run demand for cattle. Starting at point A, the two packers are near their desired operating levels in a steady \$70 market. But the supply of market-ready cattle then dips significantly in the short run, and the two packers face the possibility of only getting 70 percent of their cattle needs at flat \$70 bids. This would put them each at point B if no contracting has been done by either packer.

In the absence of contracting, the two packers could afford to pay significantly higher prices to pull more cattle out of the feedlots. Both will benefit from reduced costs as operating levels move above 70 percent, and their competition for the available cattle could generate a short-run situation such as that shown by point C, a \$73 market with both firms around 85 percent of desired capacity.

With 80 percent of needs covered by contract, however, Packer A would face a lower "MVP" associated with additional cattle than will Packer B. There would be competition for the non-contracted cattle, but it will be less intense. The final situation could be that at point D, a \$72 market with each firm operating around 84 percent of desired capacity.

Implicitly, Figure 12 pictures a short-run supply and demand situation. The points B, D, and C trace out a segment of a short-run supply curve, the curve labeled SS. It will be steep and very "inelastic", especially as prices move higher. There are limits to how much the feedlots can respond on a day-to-day basis by pulling cattle that are marginally ready but had been scheduled for another 1-3 weeks of feeding. How steep and inelastic this "supply function" is will, as suggested earlier, also be influenced by how close the packers are to other feeding areas, and how feasible it will be to haul cattle in from other areas where slaughter-ready cattle are in more abundant supply.

Figure 12 also allows us to trace out two alternative short-run demand curves. Segment AC would be part of a short-run demand curve if neither packer had contracted cattle. Segment AD is part of a short-run demand curve when Packer A has 80 percent of needs contracted. At any operating level, the slope of AC is greater than the slope of AD, suggesting the change in price for a given change in the number of market-ready cattle will always be greater on AC than on AD.

Before leaving this discussion, several points need to be made by way of emphasis:

1. The price levels employed here are illustrative only. Empirical research will be needed to confirm magnitudes of price implications, and that research needs to start with good estimates of the MVP measures illustrated in Figure 11. How much a packer can afford to bid up price in an effort to move to higher operating levels will be a function of the decreases in per head or per pound costs of operation associated with moving toward the desired level of operation.
2. The initial reaction may be to focus on the \$72 market versus the \$73 market that *might* have developed, and conclude contracting means lower prices for cattle feeders. But this reaction is too simplistic. *If* the use of contracting and the feeder-packer coordination that tends to come with it stabilizes placements and fed cattle marketings over time, *then the average price offered for cattle could be higher over time because all packers' costs are reduced.* It is possible that producers receive a less variable but higher average price over time if contracting is employed. Empirical research is needed to answer the implicit questions and test the implicit hypotheses.
3. The entire development in Figure 12 assumes the buying packers compete vigorously for available supplies of cattle, and focuses on the conceptual implications of contracting. If that vigorous competition is not present in a highly concentrated market area and the packers simply "divide up" the market because they face little or no competition from other packers, then the results can be quite different. Fed cattle prices *could* be lower over time as the large packers are more nearly able to secure attractive target gross profit margins per head. If this is the case, then the emphasis surrounding contracting must swing to whether it eliminates competitive bidding which otherwise might be present and the spectre of "market power" raises its head.

It should be clear that the developments of Figure 12 are no more than a logical conceptualization of what could occur in the presence of contracting. But other conceptualizations are possible, and it is important to recognize that economic theory alone does not provide definitive answers as to the net impact of "captive supplies" of livestock. In a highly consolidated industry, firm conduct and behavior can and will change relative to that of the 1970s and early 1980s. Research is needed, but that research needs to proceed on the basis of understanding of firm objectives and related behavior and in the presence of a better theoretical framework than appears to be present in early 1990.

**Theoretical and empirical research are needed to determine the impact of captive supplies on the short-run demand for slaughter livestock and**

on the level and variability of livestock prices over time. As we move into the 1990s, it appears that much of the initial work needs to be in the area of theoretical development before empirical research can proceed.

The structural changes have implications to the price discovery process. Price discovery is a dynamic process whereby buyers and sellers analyze available information on supply and demand and seek the price level that will balance supply and demand and clear the market.

Most observers can visualize the price discovery process most clearly in a public auction that features the outcry or other visible indication of bids and offers. Prospective sellers and buyers come to the auction arena with a perception of what supply, demand, and price will be at that particular point in time. Those perceptions may have to be adjusted as the auction process proceeds, but that is part of the discovery process. No buyer, seller, or market analyst will interpret the available information in precisely the same way as other participants.

Structural change has the potential to alter the pricing processes and to influence public access to information. Contractual prices are not widely reported, and the price in some forward delivery cash contracts is tied to a market indicator such as the futures market. Packer-owned cattle or hogs are moved into slaughter with no associated price, and the base of the so-called market determined or competitively determined prices shrinks. Reporting of market activity is influenced accordingly, and this may be especially important to sporadic sellers or buyers in the market.

A fundamental and unresolved question is one of what percent of total volume must be "priced" in a competitive arena for those publicly visible prices to be representative. As heretofore visible cash prices disappear because operations are internalized or arranged via contract, the issue becomes more important. The futures markets offer visible and centrally determined prices, but there is continuing controversy over the efficiency of the futures markets and, indeed, whether futures prices are in fact competitively determined.

With cash procurement programs has come a tendency for buying packers to be short in the futures markets. This development adds fuel to the long-standing claim that packers have not been sufficiently active on the *long* side of the market, and that the futures markets will have a "downward bias" (require a risk premium) if only speculators take the long side of the markets. And as the industry changes, there is the always logical raising of questions as to whether the currently traded futures contracts

are fully meeting industry needs and discovering prices at the correct level in the system.

There is a need, therefore, for accelerated work on the price discovery process and on the closely related issue of public access to information and reporting of the markets. Offerings of the futures markets need to be examined in terms of efficiency and in terms of applicability to the needs of a changed industry.

Controlled experimentation could shed light on questions of what percent of volume is needed to generate representative prices and on whether and how demand for slaughter livestock changes with changes in industry structure. The industry cannot afford to wait until a long series of yearly price and related data are available to allow traditional econometrically oriented analyses. Information to guide private sector initiatives and the policies and procedures of public market reporting agencies is needed now.

**Research on price discovery and related informational needs will help guide private sector initiatives and public policy. Innovative and timely approaches are needed, and controlled experimentation is one possible approach.**

The list of research needs presented here is certainly not exhaustive. I close this discussion with the topic of "measuring performance". It will be one of the most important items on the research agenda, but it may also be the most difficult to accomplish.

As the most recent round of mergers and acquisitions were being considered in the 1983-86 period, there was much discussion about the need for financial prowess to do the things that would be needed to revitalize the beef, pork, and lamb sectors. There was then not much consensus about what had happened to demand, and few would to this date grant the importance to the declines in demand as a primary catalyst for structural change that I have attributed to problems on the demand side. But there was a widening feeling that something was amiss, and that "deep financial pockets" would be needed to finance the research and development and the new technologies needed. Since large firms are more likely to have this financial prowess, the consolidation was implicitly sanctioned by many industry groups, including some producer groups.

The literature offers many indications of the dimensions of performance that can be or should be examined in relation to concentration ratios, the Herfindahl index, and similar measures of industry structure. Among those often mentioned dimensions are price levels, price variability, and

profit margins. On the surface, these performance indicators appear to be quantifiable and researchable. But the situation is more complex than it appears at first blush. Price levels and price variability, for example, are a function of many economic forces. Measuring the relationship between concentration ratios and price levels requires that all the other factors that can influence price level be controlled or accounted for, and that is not easy to accomplish. Almost every economist who reviews past efforts to quantify the relationship between measures of structure and performance indicators such as price level raise the issue of model specification as a possible reason for the often conflicting results. Thus, there are methodological and analytical barriers to attempts to conduct useful research on the relationship between structure and measures of performance.

Research into the relationship between measures of structure and profit margins faces some of the same methodological problems and added problems of access to data. Some of the large firms are "closely held" and do not divulge profit information. Some of the large meatpacking firms are owned by larger corporate entities, and that presents difficulties in allocating profits to the meatpacking activity.

Connor, in writings referred to earlier in the chapter, attempted to examine profits in meatpacking and concluded they were similar to other food processing concerns. Is the 16 percent return quoted by Connor too high? Is it too low to allow the accumulation of funds to finance risky product and market development ventures? Earlier in the chapter, a decline in the farm-retail spread across the 1979-88 time period was documented. What part of this was due to increased efficiency as the industry consolidated, and what part -- if any -- was due to a change in profits? Research and investigation is needed to estimate the type of profit flow that is consistent with what is needed for industry firms to be willing and able to finance the needed progressive programs.

Related to the profit level issue, an often mentioned measure of performance is "progressiveness". A general concept, it includes the issue of how aggressive firms are in developing new products and seeking to maintain and improve alignment between industry offerings and the needs and preferences of changing consumers. The thrust of earlier arguments in this chapter was that aggressive actions in product and market development are needed to insure the future viability of the beef, pork, and lamb sectors. Are the initiatives by the private firms sufficient in this area? Are expenditures in this area by the now large firms with the related financial prowess any greater than expenditures would have been in a less concentrated industry? If not, why are the expenditures not present and

what, if any, public policies or programs could have an influence on what is being done? Answers to these and many related questions about performance of the industry are needed.

**Research is needed to clarify the relationship between structural changes in the livestock industry and overall performance of the industry. Though difficult to obtain and perhaps more qualitative in nature than most current research efforts, information is needed on what is being spent on research and development and what can be done to stimulate, if stimulation is needed, more support for product and market development.**

## *An Industry Agenda*

It is useful to think about the meat industry as an assembly line. From production through the final retail offerings, the process is one of producing and offering utility to the final consumer. Each level of economic activity along the production-marketing continuum is similar to a work station in an assembly line. It is important that a high level of inter-level coordination be achieved if the final product-price offering is to be acceptable to consumers over time.

Along an assembly line, the foreman makes sure all the stations are working together. Along the production-marketing continuum in the livestock sector, there is no such overseer and no close control. Historically, the industry has been characterized by separate ownership at all the levels, and the price mechanism was expected to generate coordinated activity. If consumers wanted the external fat off the cut of beef, pork, or lamb, that "message" was theoretically passed back down to the original producer in the form of lower prices for livestock carrying too much fat cover. Adjustments would be made at the producer level and at other levels in the system to respond to the "message" of the price mechanism.

It would be inappropriate here to discuss in detail all the problems associated with total reliance on the price mechanism as a coordinative mechanism. Even the casual observer of industry happenings would conclude there have been problems in getting a crisp and clear price signal back to the producer. As we move into the 1990s, one of the still widely discussed issues is the pressing need to move to an effective "value-based pricing" system.

It would be naive to argue that continuing and unfulfilled needs for higher levels of inter-level coordination have not been a factor in industry



change. Coming with the consolidation is a surge in emphasis on specification buying and contractual programs that attempt to gain control over the quality dimension. Volume needs and the related desire to stabilize quantity flows is arguably the driving force behind the moves to vertical integration and contractual operations, but the efforts to stabilize and focus the quality variable are there at every turn. Integrated programs can accomplish by management decree what the price mechanism has failed to accomplish.

Complicating efforts to realize higher levels of inter-level coordination has been the tendency toward adversial relationships at every interface in the system. There is a lingering perception that the only way to improve one's position is at the expense of the firm to which livestock or products are being sold or from which livestock or products are being bought. Lack of trust and confidence has blocked moves to carcass-based pricing, and carcass evaluation in some form is virtually a necessary condition for effective value-based pricing systems. There is a perception that it is a zero-sum game, and that there are no gains to working together and coordinating activities.

The industry needs to get past an adversial posture. What we do not need in the 1990s is accentuated inter-level conflict. If there is reason to be concerned about still further consolidation, then there is reason to step back and reflect on what would prompt further consolidation. There are two related hypotheses that are worthy of some thought:

1. If the only way packers can gain control and eliminate costly variability in quantity flows and quality of livestock is to produce the livestock themselves or have them produced for them, then we can expect continued moves to increase captive supplies of livestock.
2. If it is the case that gaining control over quantity and quality flows requires large size and the related financial and market power, then the failure to move toward higher levels of inter-level coordination in an open-market system will encourage further moves toward consolidation and vertical integration at the packing and the closely related feeding levels.

Building on the perspective established by those two hypotheses, an agenda to protect and enhance the economic viability of the industry should include the following:

1. Research and education programs to enhance livestock producers' knowledge of packer and processor needs in terms of type and quality of livestock and stability of quantity flows. Better understanding of

how the system operates *above* the producer level should improve the degree of inter-level coordination and mitigate the pressures for what will be controversial further moves toward consolidation and integrated activity.<sup>22</sup>

2. Research and education programs to clarify any increased efficiencies associated with large-size operations at the feeding, packing, and fabricating levels and how the benefits of any increased efficiency are distributed. Attention should be focused on (a) what benefits have accrued to producers and what impact there has been on the economic viability of producer-level activity, and (b) what benefits have accrued in the form of reduced or constrained increases in retail prices and how that has impacted the ability of beef, pork, and lamb to compete and protect market share.
3. Research and education programs to answer questions of what percentage of livestock must be traded in a "competitive" arena for the resulting prices to be representative of trade.
4. Research and education programs to identify changes in the price discovery process that have come with industry consolidation and how the changes impact on the level and variability of cash prices. Renewed interest in cash-futures interactions is needed as the futures market is used in different ways by the buying packers, and as the futures market becomes the market that is discovering price in a visible and centralized trading process.
5. Research and education programs to identify and measure contributions toward product and market development at every level of the system. Special attention should be paid to the effectiveness of the promotion and education programs coordinated by the National Livestock and Meat Board and to the expenditures and efforts in research and development at the packer-processor-fabricator level.

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<sup>22</sup> Roughly 15 years ago, I was involved in a research effort at Oklahoma State University to test the commonality, or lack thereof, in perceptions of what constitutes "value" in a feeder steer. A battery of questions was employed with a series of pictures showing several 600 lb. steers all grading Choice on the then-used grading system. The steers ranged from what would now be M1 steers to S1 steers, with the S1 steer carrying obvious flesh and finish. Almost all of the cattle feeders questioned identified the "M1" steer as the high-value animal. Most of the producers identified the "S1" steer as the high-value animal. As we move into the 1990s, a significant percentage of the stocker and feeder animals moving through the more progressive marketing programs are still small-frame cattle.

This type of agenda can be attacked only if there is a spirit of cooperation throughout the industry. If that attitude is not present, the adversarial relationships will continue and the entire industry will be the loser.

A specific example of a potential problem area is in the research and development (R&D) activity by the large packers. They can argue that what they are doing is proprietary and is nobody else's business. But part of the reason mergers and acquisitions that led to the consolidation were not resisted more rigorously was the need for financial prowess to handle the needed R&D expenditures. If the large packers are unwilling to divulge, in the aggregate or via trade group releases, the scope and magnitude of what they are doing, then the air will be charged with mistrust and the adversarial attitudes that have been so costly to the industry.

We have a long way to go. This publication and the national conference for which it is providing base material is, perhaps, an example of what we need. The August 1989 *Demand Strategy* Conference in Charleston, South Carolina that was organized and coordinated by the National Livestock and Meat Board is another example. The National Cattleman Association organized a task force on the concentration/integration issues and employed a group of "outside" experts to give us an objective look at the industry and to the implications of consolidation and changed ways of doing business. The research reported in Chapters 2 and 3 of this book and the general overview I have provided in this chapter were partly financed by a grant from the Agricultural Marketing Service of the USDA at the original initiative of the Colorado Cattle Feeders Association. Other efforts are underway.

There is a correct sense of urgency to all this. There is a danger that what we all try to do will be fragmented and lacking in proper focus. I would like to see established a National Coordinating Council that cuts across, and has representation from, every level of the system and from appropriate public agencies with a charge of providing leadership, coordination, and a focus to our research and education efforts. The Council could prepare and distribute an annual State of the Industry report that could be of immeasurable value in helping to move the industry forward.

**In closing this overview of the industry, I am concerned that the spirit of cooperation and coordination that I feel is so important will not be achieved, and that we will not see anything approaching a Coordinating Council created and the needed research-education agenda established. I hope that concern will be unjustified, and that we will see the industry working together toward common goals in the 1990s.**

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# CHAPTER 2: STRUCTURAL CHANGE: IMPLICATIONS FOR COMPETITION AND PRICING IN THE FEEDER-PACKER SUBSECTOR

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## *Introduction*

The preface to my book, *Meatpacking Competition and Pricing* (Ward 1988), states: "For several years, dramatic changes have been occurring in the U.S. meatpacking industry. ... Concerns about some of the developments have been raised periodically by livestock producers, marketing firms, journalists, politicians, academicians, public interest groups, consumer advocates, and competing meatpackers ... This book is intended to contribute to what we know about competition and pricing in the meatpacking industry."

Changes continue to occur and concerns continue to be raised. The purpose of this chapter is to provide: (1) a brief summary of structural changes and impacts (from Ward 1988); (2) an update of structural and behavioral changes in meatpacking and performance-related research; and (3) a discussion of alternatives and needs for regulatory agencies, policy-making bodies, and researchers.



## *Background and Previous Work*

Pricing and competition in the meatpacking industry has been the focus of controversy periodically since the late 1880s. Many of the current issues originated in the 1970s and increased in importance as the decade of the 1980s progressed. New and old players during the past two decades were involved in mergers, acquisitions and takeovers, spinoffs, plant openings and closings, strikes, and bankruptcies. Consolidation in the meatpacking industry occurred at a rapid pace.

Cost-competitive advantages associated with larger plants spurred the sharp move toward fewer and larger slaughtering and processing plants. Size of plants increased and plant operations became more intensive. Two shifts per day are operating in most large plants and the plants often operate on Saturdays.

The reasons for increasing firm size are less clear. Some advantages associated with larger firms may be related to financing and cost of capital, risk management, broader product lines (across protein sources), and product distribution, among others. Some people would argue that increased market power was a driving force for the consolidation. Whatever the reasons, mergers and acquisitions involving some of the largest meatpackers, most notably in 1987, greatly changed the meatpacking industry.

While meatpacking plants and firms increased in size and declined in number, changes were occurring in livestock production and feeding. Consolidation increased in the production stages also, though not as dramatically as at the packing level. Livestock producing and feeding firms became fewer in number and larger in size. Simultaneously, livestock feeding and slaughtering became more concentrated geographically.

Methods to vertically coordinate the flow of livestock between livestock feeding operations and meatpackers changed in the 1980s. Changes stemmed in large part from ownership changes caused by mergers and acquisitions and because of decreasing supplies of livestock relative to expanding meatpacking capacity. Meatpackers began feeding more livestock, contracting with livestock producers and feeders, and entering into exclusive purchasing/marketing agreements with feeders to satisfy their slaughter needs. Consequently, the emphasis shifted somewhat from vertical coordination via market prices to non-market vertical coordination (contract and ownership integration). Wayne Purcell discussed some of the economic motivations for higher levels of coordination in Chapter 1.

As the trend toward fewer and larger plants and firms occurred, measures of market power in the meatpacking industry have increased. Concentration ratios, the most common measure of market power, increased for both national and local or regional market data. And as concentration increased, so did concerns about competitive pricing of livestock and meat. Price discovery, the process of arriving at buy-and-sell prices, has increasingly become the focus of concern. Coordinated activity that is not based on the messages of open-market prices means a reduction in publicly reported prices and market information. Increased meatpacking industry consolidation means fewer buyers of livestock and fewer sellers of meat. Increased concentration among the largest meatpackers suggests the *potential* for increased market power, leading to depressed livestock prices, increased meat prices, and excessive meatpacking industry profits.

Congressional and government investigations, lawsuits, academic research, and industry studies during the early and mid 1980s (many of which were referenced in Ward 1988) resulted in mixed signals. Some studies confirmed suspicions about the magnitude of the problem, while others merely recognized a potential problem. Most people believed (myself included) that more research was needed, and more attention should focus on investigations which address identified problems, whether problems are judged to be serious or simply potentially serious.

**The controversy surrounding consolidation and relatively high levels of concentration is not new. It has reached a new height in 1990 as concentration in some sectors of the meat industry moved to unprecedented levels.**

## *Industry Initiatives*

In the past two years, several industry studies and initiatives have surfaced. The number and nature of such studies suggest an increased concern within the livestock sector regarding concentration and consolidation in meatpacking, vertical integration and non-market coordination, and price discovery.

The American Farm Bureau Federation (AFBF) has assumed a position of leadership among the major farm organizations in addressing these issues. First, the AFBF sponsored a market access study by the Agricultural Cooperative Service of the U.S. Department of Agriculture (Hogeland). Second, it sponsored a series of informational meetings which brought together representatives from several industry groups (National

Cattlemen's Association, National Pork Producers Council, American Sheep Industry Association, and Livestock Marketing Association, among others). Meatpacking industry representatives, government officials, and researchers participated in selected meetings.

The National Cattlemen's Association appointed a concentration/integration task force to address a broad array of issues, including concentration, integration, and price discovery. As part of that process, a team of "outside" economists were hired to independently study the same issues (NCA Beef Industry Concentration/Integration Task Force). The National Pork Producers Council also initiated a study to determine the extent and impacts of contract hog production.

State and regional organizations have independently studied the issues. The Colorado Cattle Feeders Association initiated a study in conjunction with the Colorado State Department of Agriculture with financial support coming from the Agricultural Marketing Service in the U.S. Department of Agriculture. Partial results from that study will be discussed later in this chapter, and some results have already been reported (Ward and Bliss). The Iowa Farm Bureau Federation also conducted a study (Livestock Marketing Study Committee). Similar organizations have organized special meetings or appointed committees to study the issues, leading to less formal reports than those cited here.

**The increased pace of activity by private-sector groups suggests concerns about structural change are mounting.**

## *Structural Change Update*

This section updates selected parts of Chapter 1 in Ward (1988). A number of significant changes have occurred since the book was written.

### **Number and Size of Plants**

The trend toward fewer and larger meatpacking plants continues. Table 1 provides a capsule summary of Packers and Stockyards Administration (P&SA), U.S. Department of Agriculture data on changes in plant numbers by size category for selected species from 1972 through 1988. Scanning down each of the three columns, representing small-to-medium sized plants for each species, reveals that the number of small-to-medium sized

plants has declined in most cases. Scanning down the right column, which represents the largest plant size category for each species, indicates that the number of larger plants has increased, except for sheep and lamb slaughter. Larger steer and heifer slaughtering plants increased from 2 to 19 over the 1972-to-1988 period; larger boxed beef plants, from 6 to 18 (since 1979); and larger hog slaughtering plants, from 19 to 33. Lamb slaughtering plants in the largest size category have declined in number, but have increased as a percentage of all plants.

Larger plants have grown significantly in importance. Figures 1 and 2 show the percent of slaughter accounted for by plants in the largest size category for each species in Table 1. Just as plant numbers in the largest size category have increased, their share of total slaughter has increased sharply. The largest steer and heifer slaughtering plants (Figure 1) accounted for 7.5 percent of total slaughter in 1972 and 65 percent in 1988, while the largest boxed beef plants accounted for 47.5 percent in 1979 and 81.5 percent in 1988. For hogs, the largest plants accounted for 35.9 percent in 1972 and 75.4 percent in 1988 (Figure 2). Recall that number of plants in the largest size category for sheep and lambs declined in number. However, Figure 2 shows that those larger plants, though fewer in number, accounted for an increasing percentage of total slaughter, from 65.6 percent in 1972 to 80.5 percent in 1988.

The continued trend toward fewer and larger plants is believed to be in response to economies of size in slaughtering and fabricating (Ward 1988). Research has shown significant cost savings per head associated with larger size plants and operating plants more intensively (for example, operating two shifts per days). Consequently, new or remodeled meatpacking plants are typically larger and more cost-efficient when operated at high levels of plant utilization. Building a single large plant, or adding a second slaughtering shift to a large existing plant, can displace several smaller plants, thus resulting in fewer and larger plants and increased concentration ratios.

## **Firm Ownership**

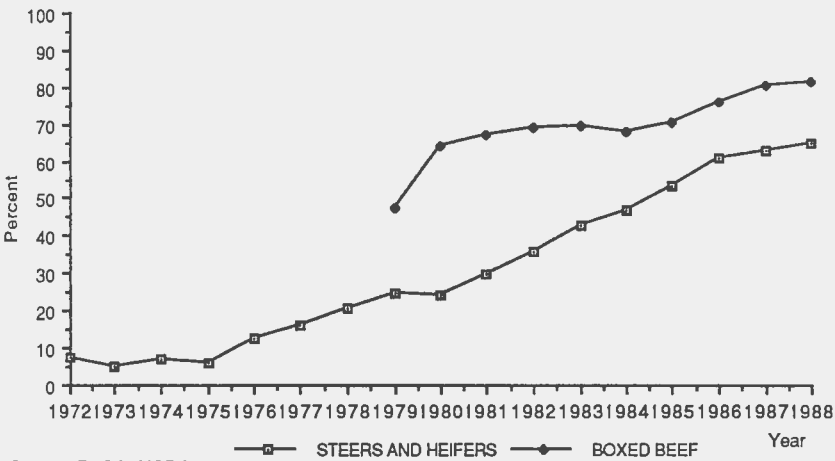
Mergers, acquisitions, plant openings and closings, and plant expansions continued in the meatpacking industry. Not all are mentioned here, but several examples are given to illustrate how dynamic the industry continues to be.

**Table 1. Number of Slaughtering Plants by Size Category, Selected Species and Years.**

Annual Steer and Heifer Slaughter Per Plant				
(Number of Head)				
Year	Less than 10,000	10,000- 99,999	100,000- 499,999	500,000- or more
(Number of Plants)				
1973	494	241	58	2
1978	411	197	66	9
1983	355	97	44	14
1988	272	53	30	19
Annual Boxed Beef Production Per Plant				
(Number of Head)				
Year	Less than 10,000	10,000- 99,999	100,000- 499,999	500,000- or more
(Number of Plants)				
1979	47	30	18	6
1983	32	25	16	13
1988	38	28	13	18
Annual Hog Slaughter Per Plant				
(Number of Head)				
Year	Less than 10,000	10,000- 299,000	300,000- 999,999	1,000,000 or more
(Number of Plants)				
1973	284	200	61	19
1978	233	161	48	25
1983	250	143	36	32
1988	175	117	24	33
Annual Sheep and Lamb Slaughter Per Plant				
(Number of Head)				
Year	Less than 10,000	10,000- 99,999	100,000- 299,999	300,000 or more
(Number of Plants)				
1973	181	20	13	12
1978	153	14	10	5
1983	159	11	5	9
1988	112	9	3	8

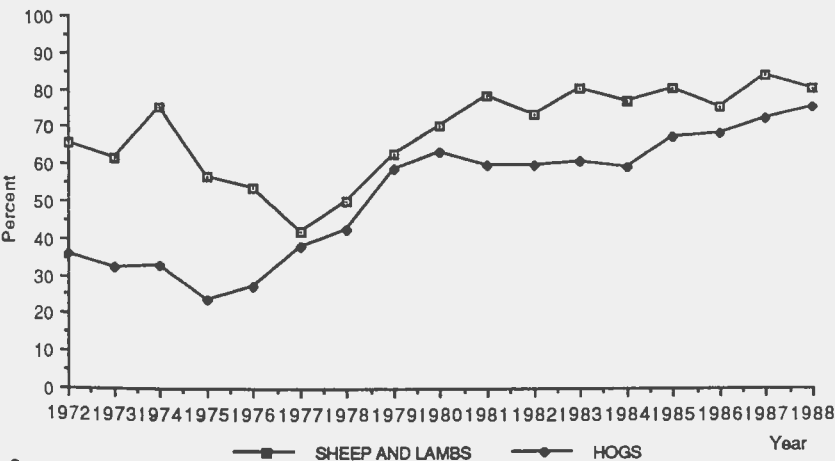
Source: Packers and Stockyards Administration, USDA.

**Figure 1. Percent of Total Volume by the Largest Steer and Heifer Slaughtering and Boxed Beef Production Plants, 1972 to 1988.**



Source: P&SA, USDA.

**Figure 2. Percent of Total Slaughter by the Largest Hog Slaughtering and Sheep and Lamb Slaughtering Plants, 1972 to 1988.**



Source: P&SA, USDA.

The Big 3 firms (IBP, ConAgra, and Excel), though involved in relatively few mergers and acquisitions the past two years, continued to grow. IBP purchased and expanded a hog slaughtering plant in Iowa from Oscar Mayer Foods, and began building another large hog slaughtering plant in Iowa. IBP also announced plans to build a large steer and heifer slaughtering and boxed beef plant in Nebraska. ConAgra expanded several of its steer and heifer slaughtering plants, converted one slaughtering plant into a fabrication plant, and added a second shift to each of its hog slaughtering plants. It also closed a lamb slaughtering plant in California, but opened a larger one in Colorado. Excel closed a steer and heifer slaughtering plant and another fabricating plant, but announced plans to expand one of its steer and heifer slaughtering and boxed beef plants in Colorado. It built Canada's largest cattle slaughtering and fabricating plant in Alberta, which has significantly affected the Canadian meatpacking industry. Excel's Canadian plant has also affected cattle procurement/marketing in the northwestern U.S.

Below the Big 3, there were several changes. Packerland Packing purchased Peck Foods from Sara Lee Corp., making Packerland the largest cow slaughtering firm and among the six-largest steer and heifer slaughtering firms. Dubuque Packing joined with Beef Nebraska and Nebraska Boxed Beef to form BeefAmerica. It expanded selected plants and closed another, leaving it among the six largest steer and heifer slaughtering firms.

The biggest acquisition in the hog industry was Dorskil Cos.' purchase of Wilson Foods. Dorskil then sold one of Wilson Foods' hog slaughtering plants and has attempted to sell the other two. Sara Lee reduced its beef business by selling Peck Foods to Packerland, but expanded its pork processing business by purchasing Hygrade Food Products. The pork industry continued to see established pork processing firms discontinue hog slaughtering. Oscar Mayer sold its last slaughtering plant, and George A. Hormel leased the slaughtering facility at its corporate headquarters to Quality Pork Processors.

Several cow slaughtering plants and/or firms engaged in cow slaughter closed or merged to become more viable and more competitive. The Packerland-Peck merger mentioned above is one example. Another is the purchase of three firms primarily involved in cow slaughtering (Cimpl, Long Prairie Packing, and Sunstar Foods) by Rosen's Diversified. The American Foods Group (formerly Consolidated Beef Industries) merged with Weinstein International, thereby further diversifying into pork and also into seafood.

Several foreign-owned firms purchased U.S. meatpackers. Elders IXL, an Australian firm, purchased Tama Meat Packing. A subsidiary of Farmland Trading Ltd. of Tokyo, a Japanese firm, purchased Washington Beef. Mitsubishi, another Japanese firm, announced plans to join with Central Soya, owned by an Italian firm, to build a hog slaughtering plant (Indiana Packers Inc.) in Indiana. British Petroleum, through its ownership of Purina Mills, purchased two hog slaughtering plants. An Israeli investor, through BJF Holding Co., purchased Dinner Bell Foods and Emge Packing. And Pagewood N.V., a Dutch firm, agreed to purchase Gartner-Harf.

**Mergers and acquisitions stemmed from several factors. Some realignment in companies represented changing marketing strategies and move toward diversification. Some changes resulted from reduced livestock supplies in certain regions and the need to form larger, more cost-efficient firms, and some were in response to increasing local or regional livestock production relative to slaughtering capacity. Generally, mergers and acquisitions occurred because at least one firm saw an opportunity or need to adjust to changing market conditions, and believed consolidation would benefit the now larger firm.**

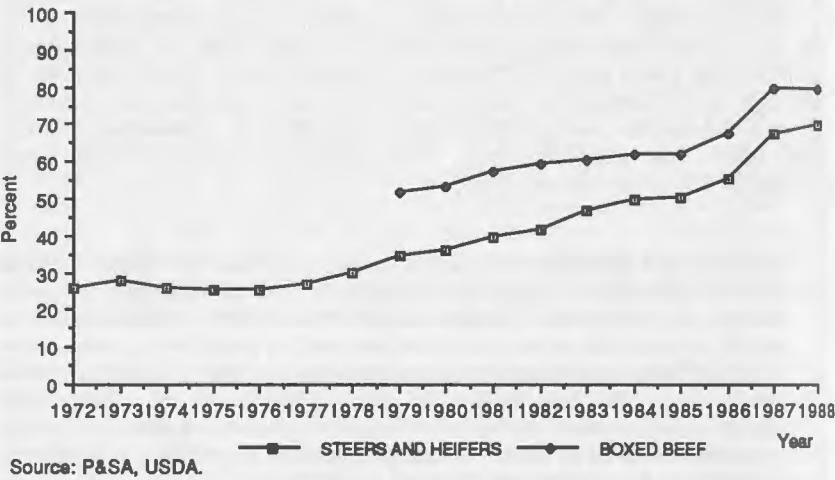
## **Concentration**

Mergers, acquisitions, and firms going out of business reduce the total number of meatpacking firms and increase the proportion of total slaughter accounted for by large firms. Almost by definition, then, concentration has continued. Figures 3 and 4 show how the combined market share of the four largest firms changed over time based on P&SA data. It should be noted that: (1) four-firm concentration ratios are based on total U.S. commercial slaughter; (2) the four largest firms are not necessarily the same for each species; and (3) the four largest firms may vary from year to year within species.

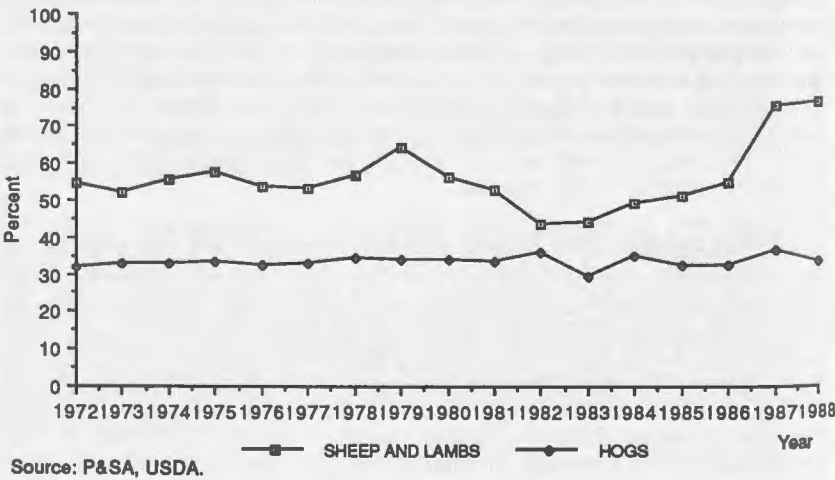
Four-firm concentration in steer and heifer slaughtering has received the most attention. Figure 3 indicates why. Four-firm concentration ratios for steer and heifer slaughtering have increased sharply since the mid-1970s, going from 25.2 percent in 1976 to 69.7 percent in 1988. Consequently, the four largest firms slaughtered almost 70 percent of all steers and heifers slaughtered in the U.S. in 1988. Concentration in boxed beef production remains higher than for steer and heifer slaughter, and has also increased sharply. The four-largest boxed beef producers in 1979 accounted for 51.3 percent of total production, compared with 79.3 per-



**Figure 3. Four-Firm Concentration In Steer and Heifer Slaughtering, 1972 to 1988, and Boxed Beef Production, 1979 to 1988.**



**Figure 4. Four-Firm Concentration In Hog Slaughtering and Sheep and Lamb Slaughtering, 1972 to 1988.**



cent in 1988. A sharp one-year increase in concentration from 1986 to 1987 (12 percentage points, both for steer and heifer slaughter and for boxed beef production) resulted largely from mergers and acquisitions (ConAgra's purchase of Monfort of Colorado and Swift Independent, and Excel's purchase of Spencer Beef and Sterling Beef).

Comparable four-firm concentration data are shown in Figure 4 for hog slaughtering and sheep and lamb slaughtering. Four-firm concentration in hog slaughtering has not increased over the 1972-to-1988 period. Four-firm concentration was 31.6 percent in 1972 and 33.5 in 1988. However, several analysts (including myself) expect an increase in hog slaughtering concentration over the next few years. The picture for sheep and lambs also differs somewhat from other species. Four-firm concentration declined during the 1972-to-1982 period, and then increased rapidly since 1982. Four-firm concentration was 54.7 percent in 1972, 43.6 in 1982, and 76.5 in 1988. The sharp one-year increase from 1986 to 1987 also reflects mergers and acquisitions by ConAgra.

To put the concentration data in perspective, many economists classify an industry or market as oligopolistic (for sales) or oligopsonistic (for purchases) when the four-firm concentration ratio exceeds 35-40 percent. Clearly, steer and heifer slaughtering and sheep and lamb slaughtering resemble oligopsonistic markets in structure. Boxed beef production resembles an oligopolistic market in structure. Hog slaughtering appears not to be oligopsonistic in structure based on national data. However, as was shown in Ward (1988), concentration measured in smaller market areas (for example, an individual state) is typically considerably higher than when using national market data.

Realistically, an increase in concentration can be expected in steer and heifer slaughtering and boxed beef production in the near future, based on expansion decisions by the Big 3 during the past two years. Similar reasoning suggests a larger increase in concentration can be expected in hog slaughtering. No significant change in concentration for sheep and lamb slaughtering appears evident in the near future.

**The possibility of sharp increases in concentration in hogs during the 1990s will be an important component of the discussions, public and private, in this area. Consolidation is a fact in cattle and in sheep, but decisions may still be made on merger or acquisition requests that would consolidate the hog sector.**

## *Procurement Practices Update*

Market structure alone does not necessarily indicate non-competitive behavior among firms in an industry, nor does it necessarily indicate poor economic performance. This section addresses some of the behavioral aspects of meatpacker procurement, and is intended to update earlier work.

Data were collected from feedlots in July 1979 to study pricing and procurement practices of meatpackers as a follow-up to a series of intensive visits with five meatpackers regarding cattle procurement and beef marketing. This earlier study is discussed in *Meatpacking Competition and Pricing*. A similar study was undertaken in June 1989, both as a comparison with the earlier period and to focus on specific changes which had occurred since the late 1970s.

### **Methodology and Data**

Four major cattle feeding regions were chosen for study. Each has predominantly commercial cattle feedlots, which made data collection more cost-efficient. Data collection forms were mailed to 223 feedlots in the selected regions. Mailings by region were: (1) Northeast Colorado (approximately north and east of Denver), 50 feedlots; (2) Southwest Kansas (approximately south and west of Ness City) and Southeastern Colorado (approximately south and east of La Junta), 66 feedlots; (3) North Texas High Plains (approximately north of Amarillo) and the Oklahoma Panhandle (approximately west of Laverne), 51 feedlots; and (4) South Texas High Plains (approximately south of Amarillo to Lubbock), 56 feedlots.<sup>23</sup>

Persons completing data forms could identify the feedlot or maintain feedlot anonymity. Most chose the latter. Data forms were grouped by weeks. Table 2 shows the feedlot-week responses by number of head reported sold that week for the four full weeks of June 1989. Both number and percentage of responses were highest for the three southernmost regions (Southwest Kansas, North Texas High Plains, and South Texas High Plains). To put weekly marketings in perspective, if a feedlot marketed 100 cattle each week, annual marketings would exceed 5,000 head; and for 3,000 head marketed each week, annual marketings would exceed 150,000 cattle. Number and percent of responses were greatest (53

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<sup>23</sup> Regions are referred to as Northeast Colorado, Southwest Kansas, North Texas High Plains, and South Texas High Plains, respectively, throughout this chapter.

feedlots, 34.9 percent) for feedlots that marketed an estimated 10,000 to 25,000 cattle annually (weekly marketings of 200-499 cattle).

**Table 2. Number of Feedlot-Week Responses by Region and Size Category, Four Full Weeks, June 1989.**

Size Category (Number of Head Sold per Week)	Region				
	Northeast Colorado	Southwest Kansas	North Texas High Plains	South Texas High Plains	All Regions
(Number of Feedlots)					
Less than 200	5	4	13	8	30
200-499	11	14	18	10	53
500-999	4	17	5	15	41
1,000-2,999	1	2	11	7	21
3,000 or more	0	5	0	2	7
Total	21	42	47	42	152
Percent of Potential Responses	10.5	15.9	23.0	18.8	17.0

Data requested from surveyed feedlots for each day of June were divided into four sections: (1) buyer activity (packers in respondent's feedlot and those actively bidding, either in the feedlot or by phone); (2) cattle sales (number of head, sex, estimated average live weight, percent Choice grade, percent YG2-3, dressing percentage, sale price, buyer, estimated days to delivery, and number of bids from different packers); (3) forward contracting and formula sales (number of head, sex, buyer, delivery month, flat price or basis); and (4) shipments to packers (number of head, sex, buyer and plant, and number of cattle fed by/for packers, forward contracted, or sold by formula).

A caveat is necessary regarding this recent study. First, feedlots responding did so voluntarily, and respondent feedlots may not be representative of non-respondent feedlots. Therefore, technically, inferences

cannot be drawn for the entire population of cattle feedlots in the study area or throughout the U.S. from data analyzed in this study.

## **Procurement and Pricing Methods**

Based on P&SA data, meatpackers continue to procure an increasing percentage of livestock by direct methods, bypassing public markets (terminal and auction markets). Figure 5 shows the growth in direct procurement of slaughter livestock for selected species. The percentage purchased by direct methods increased between 1972 and 1988 from 77 to 92.4 for steers and heifers; from 70.4 to 89.5 for hogs; and from 74.3 to 81.9 for sheep and lambs. Consequently, the percentage of slaughter livestock purchased by meatpackers through public markets in 1988 was 7.6 percent for steers and heifers, 10.5 percent for hogs, and 18.1 percent for sheep and lambs.

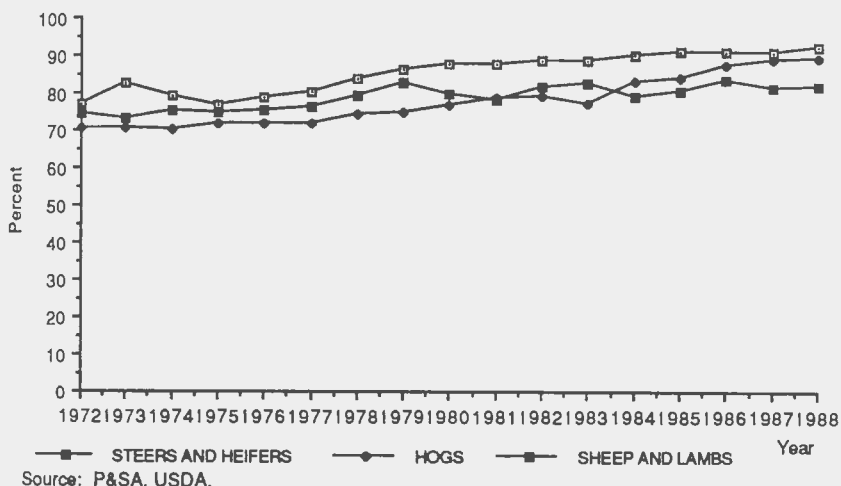
Direct purchasing/marketing has advantages for both buyers and sellers. However, one disadvantage is that it makes the pricing process less visible. Packers can price livestock several ways when purchasing by direct methods (for example, based on liveweight, dressed weight, dressed weight and grade, or by formula). At public markets, livestock are priced usually on a liveweight basis.

A high percentage of cattle purchased directly from commercial feedlots during July 1979 were priced on a liveweight basis (97.5 percent). Of cattle reported sold from respondent feedlots during June 1989, 92.2 percent were priced on a liveweight basis. Nearly half (46.3 percent) of all sale lots priced on a dressed weight basis were sold from Northeast Colorado feedlots. Excluding Northeast Colorado, 95.6 percent of reported sale lots were priced on a liveweight basis.

## **Captive Supplies of Livestock for Slaughter**

The term "captive supplies" refers to packers purchasing livestock well in advance of slaughter and thereby "capturing" some portion of their immediate slaughter needs. Packers may obtain captive supplies in several ways, by: (1) packer feeding (feeding livestock in packer-owned feedlots or facilities, or custom feeding livestock in commercial feedlots or facilities); (2) contracting (forward pricing contracts or production contracts); or (3) purchasing/marketing agreements with livestock producers and feeders.

**Figure 5. Percent of Slaughter Purchased by Direct Methods, Selected Species, 1972 to 1988.**



Some examples for specific firms (not meant to be exclusive) are given to illustrate alternative means of securing captive supplies of livestock. ConAgra, through Monfort of Colorado which it purchased in 1987, feeds cattle and lambs in company-owned feedlots. Excel feeds cattle in several custom feedlots and also purchases cattle by forward contract (for example, a feedlot manager would agree today to sell cattle to Excel for future delivery, at a price determined today or some time in the future, based on a specified futures market price, or in some agreed-upon manner). Production contracts are common in the poultry industry and are becoming more common in hog production. Smithfield Foods plans to increase its use of hog production contracts to secure its slaughter needs (for example, producers are paid to produce hogs to a predetermined weight and condition for a price, which is often tied to feed efficiency, rate of gain, death loss, or other measures of feeding performance). IBP has entered into purchasing/marketing agreements with at least two large cattle feeding firms (Cactus Feeders and National Farms). Each firm agrees to market all or a specified number or percentage of cattle to IBP on a predetermined schedule with price determined in a specified manner.

## **Captive Supplies - Slaughter Lambs and Hogs**

Captive supplies are significant for slaughter lambs. According to P&SA data, packer feeding accounted for 30.1 percent of total sheep and lambs slaughtered in 1988 (Packers and Stockyards Administration). Seven states (Colorado, California, Texas, Washington, Kansas, Iowa, and Minnesota) accounted for virtually all packer feeding of lambs. There are relatively few large sheep and lamb slaughtering plants in the U.S. Those owned by large corporations (such as ConAgra) feed lambs, and of the remaining plants, most are partially-owned or wholly-owned by lamb feeders. How accurately P&SA data portray the true extent of captive supplies in slaughter lambs is not known.

P&SA data indicate that packer feeding of hogs amounted to just .2 percent of commercial hog slaughter in 1988. Contract hog production is increasing but data on hog contracting are not included in packer feeding reports to P&SA. A University of Missouri study in 1989 (full results are not yet available) estimated hog contracting to be 9-10 percent of total U.S. hog slaughter. Relatively few packers are actively contracting with hog producers. To date, most hog production contracting involves grain and feed suppliers rather than hog slaughtering firms. However, many analysts agree that production contracts involving packers will increase, with or without grain and feed firm involvement.

## **Captive Supplies - Fed Cattle**

Captive supplies of fed cattle increased sharply during the 1980s. Regularly published P&SA data do not accurately depict the extent of captive supplies, prompting P&SA in 1989 to conduct a special study of captive supplies. The fifteen largest steer and heifer slaughtering firms were contacted and information obtained on captive supplies for 1988. The 15 firms accounted for 84 percent of U.S. commercial steer and heifer slaughter, 91 percent in the High Plains (Texas High Plains, approximately north of Lubbock, and Kansas) and Colorado, and 94 percent in Nebraska and Iowa. Table 3 summarizes P&SA findings. Captive supplies were larger in the High Plains and Colorado region (25 percent of total slaughter by the 15 firms) than in Nebraska and Iowa (9 percent). In both regions, the percentage of fed cattle procured by contract or marketing agreement was considerably larger than packer feeding. Procurement by contract/marketing agreement was 19 percent in the High Plains-Colorado region vs. 6 percent for packer feeding. In the Nebraska-Iowa region, comparable figures were 14 and 5 percent, re-

spectively. Captive supplies varied considerably from month-to-month and plant-to-plant according to the P&SA study.

**Table 3. Percent Captive Supplies of Fed Cattle by the 15 Largest Steer and Heifer Slaughtering Firms, Selected Regions, 1988.**

Region	Captive Supplies								
	Packer Feeding			Contract and Marketing Agreement			Total Captive Supplies		
	High Month	Low Month	Annual Average	High Month	Low Month	Annual Average	High Month	Low Month	Annual Average
	(Percent of 15-Firm Slaughter)								
High Plains and Colorado <sup>1</sup>	8	5	6	33	11	19	39	16	25
Nebraska and Iowa	3	.1	2	17	2	7	18	3	9
All Regions	7	3	5	24	8	14	29	13	19

<sup>1</sup>High Plains includes the Texas High Plains (approximately north of Lubbock) and Kansas.

Source: Packers and Stockyards Administration, USDA.

P&SA also reported captive supply data for just the four largest steer and heifer slaughtering firms. Captive supplies were 21 percent of their total slaughter, 2 percentage points above the 15-firm total. All the increase was attributable to higher contract/marketing agreement procurement, 16 percent for the 4 largest firms compared with 14 percent for the 15 largest firms.

Ward and Bliss reported the extent of forward contracting by cattle feeders, based on a 1989 survey of about 3,700 cattle feedlots in the 13 major cattle feeding states. For the 503 feeders responding to the survey, forward contracting accounted for 12.7 percent of their reported fed cattle marketings in 1988. Tables 4 and 5 summarize the findings by state and feedlot size. Consistent with the P&SA findings (based on data from packers), most contracting was in the Plains states (Texas, Kansas, Nebraska, Colorado, and Oklahoma). Texas and Kansas accounted for



63.4 percent of all reported contracting among feedlot-respondents. Most contracting (84 percent) was found among larger feedlots, those marketing 20,000 or more cattle in 1988. Larger feedlots also contracted a higher percentage of cattle marketed than smaller feedlots, 13.6 versus 8.5 percent, respectively.

Certainly, there is a relationship between feedlot location and size. A high percentage of the larger feedlots are also located in the Plains feeding states.

Ward and Bliss found that April 1988 was the month in which forward contracting was highest, 19.9 percent of reported marketings. Results are reasonably consistent with the P&SA study. P&SA also found that April was the month in which contract and marketing agreement procurement was highest in the High Plains and Colorado region. P&SA reported a higher percentage of cattle that were contracted or purchased under marketing agreements (33 percent) than did Ward and Bliss, but the Ward and Bliss study sought data on forward contracts only, exclusive of marketing agreements.

Packers have typically purchased fed cattle from feeders and agreed to have cattle delivered for slaughter within seven days of purchase (Ward 1988). Such a practice represents for the packer an inventory of purchased but not yet delivered cattle. While not usually considered a type of captive supply, a purchased inventory of fed cattle provides added flexibility for packers, both in purchasing cattle and in having cattle delivered from various categories (purchased but not delivered cattle, packer fed cattle, forward contracted cattle, and cattle procured under purchasing/marketing agreements).

Table 6 shows the number of days prior to slaughter for fed cattle reported sold by respondent feedlots during the four full weeks of June 1989. Nearly half of all sale lots (49.2 percent) were expected to be delivered 6 days or more after purchase. Omitting Northeast Colorado, the percentage was 51.1 percent. Five percent of fed cattle sold by respondent feeders in the Plains region during July 1979 were expected to be delivered 6 days or more after purchase. Also in July 1979, 57.7 percent of sale lots in the Plains region were estimated to be delivered within 3 days of purchase. The comparable figure for June 1989 was 26.4 percent.

Packers purchased cattle with more expected time between purchase and slaughter in 1989 than 10 years earlier. Three reasons may explain the difference. First, during July 1979, wholesale beef prices were declining and packers may have chosen not to purchase slaughter cattle any farther

**Table 4. Fed Cattle Marketed by Forward Contract, by State, 1988.**

State	Extent of Contracting, 1988		
	Forward Contracted (1,000 Head)	Percent of Reported State Total	Percent of Survey Total
Arizona	18.8	13.8	2.5
California	.4	.5	.0
Washington	8.5	8.1	1.1
Idaho	8.3	26.2	1.1
Colorado	72.0	11.7	9.5
Nebraska	91.0	12.3	12.1
Kansas	238.3	12.6	31.6
Oklahoma	37.2	10.1	4.9
Texas	240.3	15.1	31.8
South Dakota	9.4	8.0	1.2
Minnesota	2.6	4.3	.3
Iowa	16.9	8.6	2.2
Illinois	10.8	27.9	1.4
Total	754.6	12.7	99.7 <sup>1/</sup>

<sup>1/</sup> Total does not equal 100 due to rounding.

**Table 5. Fed Cattle Marketed by Forward Contract, by Feedlot Size, 1988.**

Size Category (Number of Head)	Extent of Contracting, 1988		
	Forward Contracted (1000 Head)	Percent of Reported State Total	Percent of Survey Total
250 or Less	1.6	14.0	.2
251-500	1.8	8.6	.2
501-1,000	4.6	9.4	.6
1,001-3,000	29.5	18.0	3.9
3,001-10,000	46.0	10.3	6.1
10,001-20,000	37.1	5.1	4.9
20,001-50,000	262.4	15.3	34.8
50,001 or More	371.6	12.6	49.2
Total	754.6	12.7	99.9 <sup>1/</sup>

<sup>1/</sup> Total does not equal 100 due to rounding.

**Table 6. Sale Lots of Fed Cattle Sold by Region and Number of Days Between Purchase Date and Expected Shipment Date, June 1989.**

Number of Days Between Purchase Date and Expected Shipment Date	Region				
	Northeast Colorado	Southwest Kansas	North Texas High Plains	South Texas High Plains	All Regions
(Number of Sale Lots)					
Same Day	-	-	-	-	-
1	7	18	9	5	39
2-3	21	94	38	33	186
4-5	8	51	84	65	208
6 or More	4	131	127	157	419
Total	40	294	258	260	852
(Percent of Region Total)					
Same Day	-	-	-	-	-
1	17.5	6.1	3.5	1.9	4.6
2-3	52.5	32.0	14.7	12.7	21.8
4-5	20.0	17.3	32.5	25.0	24.4
6 or More	10.0	44.6	49.2	60.4	49.2
Total	100.0	100.0	99.9 <sup>1</sup>	100.0	100.0

<sup>1</sup> Total does not equal 100 due to rounding.

"out front" than necessary. Second, packers in 1989 may have given feeders a less specific delivery date at the time of purchase, simply saying the cattle will be picked up within a week. Consequently, respondent feeders may have expected a 7-day period between purchase and delivery. Lastly, packers may consciously wait longer to pick up cattle in order to give themselves added flexibility in purchasing cattle and delivering captive supply cattle with cattle purchased within a few days of slaughter.

Cattle feeder-respondents provided data on shipments to packers and extent of captive supply cattle during June 1989. Table 7 summarizes the extent of captive supplies as a percent of shipments to packers by respondent feedlots for the four full weeks of June 1989. For the month, captive supplies represented 36.7 percent of reported shipments. Captive

supplies ranged from 29.1 percent to 49.8 across the four weeks, and from 9.5 percent to 47.6 across the four regions. Individual region-week combinations ranged from 0 to 78.7 percent, but are subject to more influence by the number and size of reporting feedlots.

**Table 7. Percent of Fed Cattle Shipments Fed by or for Packers, Forward Contracted, or Marketed under a Marketing Agreement, by Region and Week, June 1989.**

Region	Number of Cattle Shipped and Percent Captive Supplies	Week				Four-Week Total
		June 4-10	June 11-17	June 18-24	June 25-30	
Northeast	Shipments	2,632	558	1,212	2,232	6,634
Colorado	Captive Supplies	0	61.5	8.2	8.5	9.5
Southwest	Shipments	9,023	11,347	8,711	3,867	32,948
Kansas	Captive Supplies	10.6	12.5	22.4	14.0	14.8
North Texas	Shipments	17,628	13,284	13,199	6,650	50,761
High Plains	Captive Supplies	54.8	46.7	42.0	41.0	47.6
South Texas	Shipments	13,663	9,348	8,248	12,182	43,441
High Plains	Captive Supplies	78.7	22.2	18.7	41.4	44.7
All Regions	Shipments	42,946	34,537	31,370	24,931	133,784
	Captive Supplies	49.8	29.1	29.1	34.1	36.7

Peak captive supplies in 1988, according to the 1989 P&SA study, were 39 percent of the 15-firm total steer and heifer slaughter in the High Plains and Colorado region. For the average to be 39 percent, captive supplies in some weeks were likely considerably above and below 39 percent. While data reported from feedlots in 1989 are not comparable to data collected from packers in 1988, there is reasonable consistency in the percent of captive supplies between the two independent studies.

A further examination of the captive supply data from feedlots indicates that the actual percentage of captive supplies in June 1989 could be even

higher than reported by respondent feedlots. For example, P&SA reported packer feeding in Colorado to be 15.3 percent of steer and heifer slaughter in the state for 1988 (Packers and Stockyards Administration). The 15.3 percent is packer feeding alone and does not include procurement by forward contract or under purchasing/marketing agreements. Also, the number of respondent-feedlots reporting shipment and captive supply data for Colorado was relatively small. Consequently, the percentage of captive supplies in Colorado reported in Table 7 likely understates the actual extent of captive supplies. Further, one large cattle feeding firm, which admitted feeding cattle for packers or marketing cattle to packers by forward contract or marketing agreement, indicated that it would not participate in the study. Not having such firms in the study could also result in the extent of captive supplies being understated. Conceivably, however, some respondent-feeders may have fed more cattle for packers or marketed a higher percentage of fed cattle by forward contract or under marketing agreements than respondent feedlots. In the latter case, reported captive supplies in Table 7 could overstate actual captive supplies.

**There is a clear and documented move by beefpackers to gain control over a significant level of fed cattle supply. In Chapter 1, Wayne Purcell identified what he believes to be powerful economic incentives to move toward captive supplies and to gain control over fed cattle flows. Results of the 1989 survey appear to confirm the importance of that control to packers.**

## **Market Shares of Purchases, Deliveries, and Captive Supplies**

Concentration was significantly higher with local or regional market data in 1979 than with national data (Ward 1988). The four largest buyers in the Plains region during July 1979 accounted for 80.8 percent of reported marketings by respondent feedlots. Based on national data from P&SA, the four largest buyers had a combined market share of 34.5 percent.

Similar results between local/regional and national concentration were found in 1989. The four largest buyers (Excel, IBP, ConAgra, and National Beef) in the four study regions accounted for 96.2 percent of respondent feedlots' reported marketings during the four full weeks of June 1989, and 96.4 percent of their shipments to packers. Recall that the four largest firms slaughtering steers and heifers in 1988 had a combined market share of 69.7 percent. Consequently, concentration has increased in local or regional markets just as it has nationally. The Big 3 firms also

accounted for 96.3 percent of captive supplies reported by respondent feedlots during the same four-week period.

Meatpackers purchasing directly from livestock producers and feeders can purchase livestock at regular or irregular intervals. However, to maintain high utilization rates for slaughtering plants, deliveries for slaughter are expected to be more consistent from day-to-day and week-to-week than are purchases. Large differences between purchases and shipments suggest packers attempt to strategically purchase livestock, anticipating significant changes in livestock and/or meat prices, or packers use captive supplies to smooth the flow of livestock shipments for slaughter from irregular livestock purchases. Over an increasingly longer period (from a week, to a month, to a year), differences between packer purchases and deliveries should narrow and eventually disappear. Also, over increasingly-longer time periods, market shares of buyers should approximate their relative slaughter volume (considering plant capacity and utilization rate) in a given region.

Market shares of reported purchases, shipments, and captive supplies for individual packers are shown in Table 8 for each region and for the four regions combined. Considerable variation was found among regions, and (not shown) among weeks within regions. Significant differences can be found for some packers and regions between purchases and shipments. Similarly, market shares of purchases and shipments, in some cases, do not accurately represent estimated slaughter capacity and volume among packers within and between regions.

**A few large firms dominate procurement in fed cattle, especially at the regional or more local level. In some areas, there is little or no alternative to three or four dominant packers. Growing awareness of these trends has fueled the increased level of concern regarding what this means for competition and pricing and what the future holds for livestock feeders, especially smaller ones.**

## **Bids Per Sale Lot**

Mergers, acquisitions, and firms exiting the industry have reduced the number of competing meatpackers in many local and regional market areas. Fewer and larger packers and increased concentration translates into fewer buyers for livestock on a day-to-day basis. Data in Table 8 indicate that for the four weeks of June 1989, three packers purchased fed cattle from respondent feedlots in Northeast Colorado, four packers in Southwest Kansas, six packers in the North Texas High Plains, and nine

**Table 8. Buyer Share of Purchases, Shipments, and Captive Supplies, by Region and Packer, June 1989.**

		Packer								
Region	Category	IBP	ConAgra	Excel	National Beef	Hyplains Dressed Beef	Clovis/Booker Packing	John Morrell	Caviness Packing	Handy Packing
(Percent)										
Northeast Colorado	Purchases	10.8	71.4	17.8						
	Shipments	7.6	74.4	18.0						
	Captive Supplies	0	31.6	68.4						
Southwest Kansas	Purchases	38.4	22.7	4.8	30.6	3.4				
	Shipments	29.5	27.2	7.0	30.2	6.0				
	Captive Supplies	48.6	4.5	28.5	0	18.4				
North Texas High Plains	Purchases	29.8	20.5	17.3	28.0	4.2	.1			
	Shipments	38.4	11.0	33.5	13.9	3.2	0			
	Captive Supplies	44.9	.5	51.4	.9	2.3	0			
South Texas High Plains	Purchases	9.2	20.7	65.4	.3	0	.2	2.7	.8	.6
	Shipments	5.4	20.6	71.5	0	.1	.1	.7	1.4	.2
	Captive Supplies	3.8	26.0	69.5	0	0	0	.7	0	0
All Regions	Purchases	25.3	24.7	27.6	18.6	1.2	1.2	.8	.3	.2
	Shipments	23.9	21.2	38.6	12.7	1.5	1.2	.2	.5	.1
	Captive Supplies	28.4	11.4	56.5	.4	1.8	1.1	.3	0	0

packers in the South Texas High Plains. However, in some instances, smaller buyers had an insignificant proportion of both purchases and shipments.

Feedlots surveyed were asked to record the number of bids from different packers for fed cattle sold during the study period. Data indicate that number of bids per sale lot has declined over the past decade. During July 1979 in the Plains region, 34 percent of reported sale lots received bids from three or more buyers (Ward 1988). For June 1989 in the four study regions, 15.6 percent of reported sale lots received bids from three or more buyers, with no sale lots receiving bids from more than four buyers (Table 9). Consequently, 84.3 percent of the reported sale lots received bids from just one or two packers in 1989, compared with 66 percent in 1979. And half of the reported sale lots (50.7 percent) in 1989 were sold with a single packer bidding on them. The percentage of sale lots sold with just one or two packers bidding varied across regions, ranging from 76.8 to 96.2 percent in the North Texas High Plains and Northeast Colorado regions, respectively.

Hogeland's survey results indicated livestock producers have received fewer bids for all slaughter livestock since 1982. A higher percentage of fed cattle, slaughter hogs, and slaughter lambs were sold with just one or two bids in 1987-88 compared with 1982. Nearly half (48.7 percent) of the respondents in Hogeland's survey were from Iowa and Illinois, representing predominantly relatively small livestock operations. Therefore, both larger and smaller livestock producers and feeders have been affected by the reduced number of packers.

## **Buyer Activity**

Fewer buyers and increased captive supplies suggest the possibility that daily or weekly purchases of livestock are more variable than when more buyers competed for livestock and buyers did not have captive supplies to draw from for their immediate slaughter needs. As a consequence, day-to-day buyer activity may also vary. Surveyed feedlots were asked to record each day the buyer activity in their feedlot. Four possibilities existed: (1) no buyers were in the feedlot; (2) buyers were in the feedlot but were not judged to be "actively" bidding; (3) buyers were in the feedlot and actively bidding; and (4) no buyers were in the feedlot but buyers were actively bidding by phone.



**Table 9. Sale Lots Sold by Number of Bids from Different Packers, by Region, June 1989.**

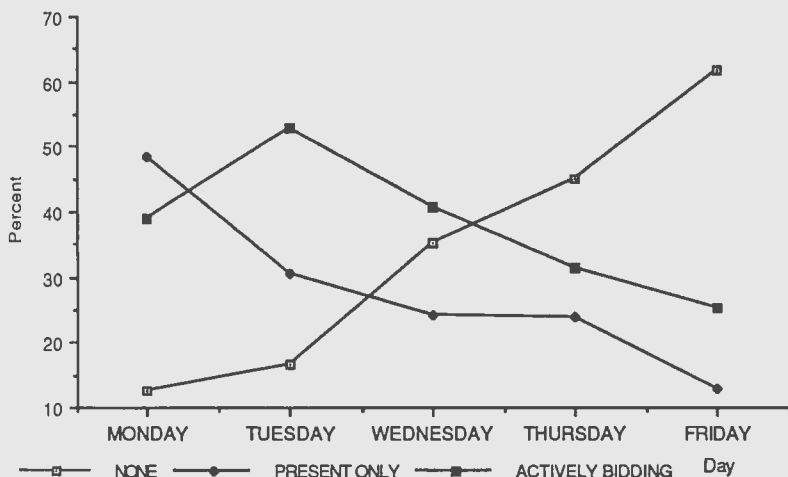
Number of Bids from Different Packers	Region				
	Northeast Colorado	Southwest Kansas	North Texas High Plains	South Texas High Plains	All Regions
(Number of Sale Lots)					
1	38	158	121	127	444
2	13	97	84	100	294
3	2	40	50	29	121
4	0	2	12	2	16
Total	53	297	267	258	875
(Percent of Region Total)					
1	71.7	53.2	45.3	49.2	50.7
2	24.5	32.6	31.5	38.8	33.6
3	3.8	13.5	18.7	11.2	13.8
4	0	.7	4.5	.8	1.8
Total	100.0	100.0	100.0	100.0	99.9 <sup>1</sup>

<sup>1</sup> Total does not equal 100 due to rounding.

Buyer activity was found to have a within-week pattern. Two categories were combined, since both represent active bidding (buyers in the feedlot who were actively bidding and buyers not in the feedlot but actively bidding by phone). The percentage of feedlots reporting no buyer activity increased each day from Monday to Friday (Figure 6). Buyers in the feedlot but not actively bidding essentially mirrored "no buyer activity", beginning the week at its highest level and declining throughout the week. Active bidding was relatively high on Monday, increased to its peak on Tuesday, and then dropped off the remainder of the week. Buyer activity data are summarized by region and day of week in Table 10. While there were exceptions, a similar pattern was observed across the four study regions.

As would be expected, both number of bids and buyer activity has declined since the earlier study in 1979. During July of 1989, roughly

**Figure 6. Percent of Feedlots Reporting Buyer Activity, by Day of Week, June 1989.**



one-half the cattle sold by the responding feedlots were sold to the only one or two packers that extended a bid.

### *Price and Profit Performance Update*

Performance-related research and information can be divided into two categories: (1) that which focuses on the industry as a whole; and (2) that which focuses more specifically on the price discovery process.<sup>24</sup>

<sup>24</sup> A discussion of some of the available literature was included in Chapter 1. The focus here will be on the available research that relates most closely to the impact of consolidation on competition, pricing, and industry performance in the livestock feeder-packer subsector.

**Table 10. Packer Buying Activity by Region and Day of Week, June 1989.**

Day of Week	Buying Activity Category	Region				All Regions
		Northeast Colorado	Southwest Kansas	North Texas High Plains	South Texas High Plains	
(Percent of Day Total)						
Monday	None <sup>1</sup>	50.0	6.5	5.8	12.3	12.6
	Present Only <sup>2</sup>	25.0	54.3	49.6	50.0	48.5
	Actively Bidding <sup>3</sup>	25.0	39.1	44.5	37.7	38.9
Tuesday	None	44.6	15.5	8.0	12.0	16.7
	Present Only	8.9	29.3	39.8	33.7	30.5
	Actively Bidding	46.4	55.2	52.2	54.3	52.8
Wednesday	None	54.2	29.7	31.9	30.0	35.2
	Present Only	27.1	22.0	25.0	24.3	24.2
	Actively Bidding	18.6	48.4	44.4	45.7	40.6
Thursday	None	77.8	33.3	38.8	44.1	44.8
	Present Only	8.9	25.0	35.0	19.1	23.8
	Actively Bidding	13.3	41.7	26.2	36.8	31.4
Friday	None	83.0	54.8	61.0	53.1	61.6
	Present Only	6.4	16.1	20.3	7.8	12.9
	Actively Bidding	10.6	29.0	18.6	39.1	25.4

1 Feedlot respondents reported no buyers in their feedlot.

2 Feedlot respondents reported buyers in their feedlot but not actively bidding.

3 Feedlot respondents reported buyers actively bidding, either in their feedlot or by phone.

## Industry-Wide Research and Information

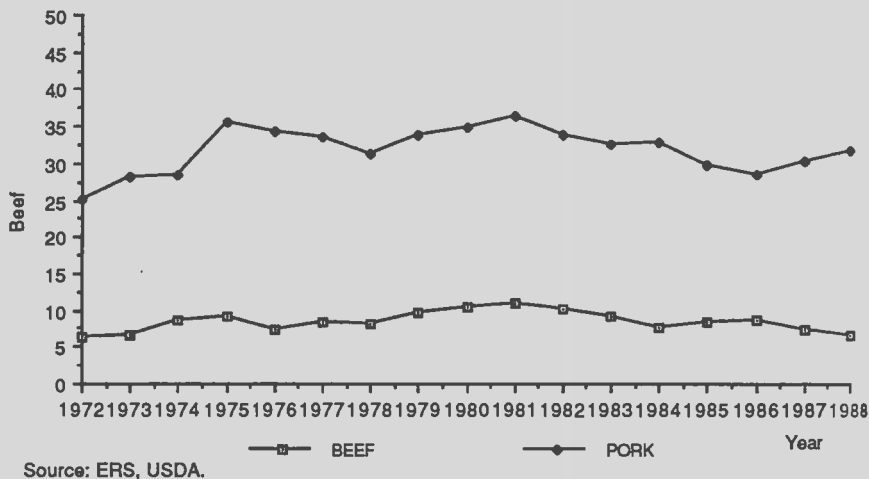
Schroeter found small but significant monopoly/monopsony price distortions in slaughter cattle and wholesale beef markets between 1951 and 1983. However, after 1977 and up to 1983, when concentration in steer and heifer slaughter increased more rapidly, there was no increase in magnitude of the estimated price distortions. Azzam and Pagoulatos refined the Schroeter model and included data for the entire meatpacking industry for the years 1959 to 1982. Unlike Schroeter, Azzam and Pagoulatos found no evidence of monopoly price distortion. However, like Schroeter, they found evidence of monopsony price distortions in livestock procurement. Both studies were limited because they used aggregated industry data for annual time periods. Data aggregation also caused researchers to make assumptions which may not be correct for the meatpacking industry.

Other industry-wide data continue to show no evidence of monopoly or monopsony power by meatpackers. Economies of size have enabled the meatpacking industry to move toward fewer and larger firms and increase industry efficiency in the process. Figure 7 shows Economic Research Service (ERS), U.S. Department of Agriculture data on farm-to-wholesale price spreads for pork and farm-to-carass price spreads for beef. Farm-to-wholesale price spreads for pork have fluctuated since 1972, increasing slightly over the entire period but declining generally since 1981. Farm-to-carass price spreads for beef have also declined since 1981, matching in 1988 the level of 15 years earlier (1973). After accounting for inflation, price spreads for both pork and beef have declined sharply, suggesting increased efficiency in livestock slaughtering over time.

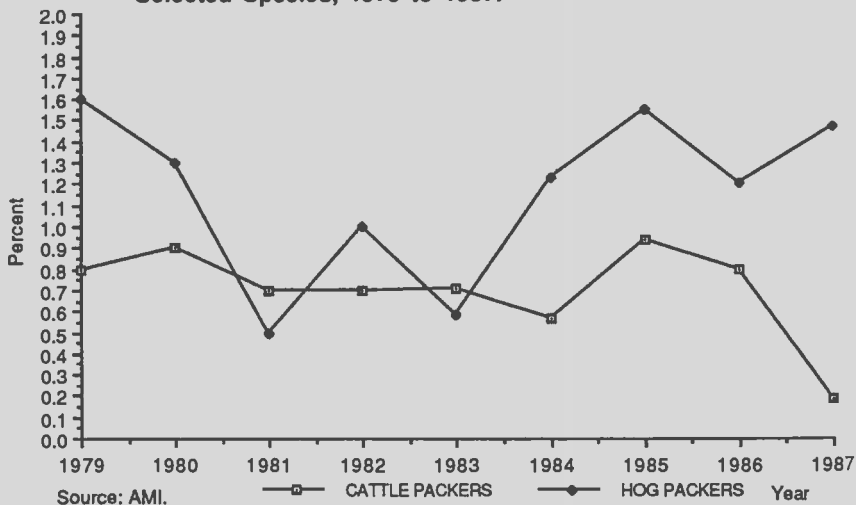
If packers have exerted monopoly or monopsony market power, profit rates should have increased. However, available data suggest profit rates in meatpacking have not increased over time. Figure 8 shows net earnings as a percent of sales for meatpackers handling predominantly cattle and hogs, respectively, from 1979 to 1987. Earnings data were based on a survey of meatpacker-members in the largest meatpacking trade organization, the American Meat Institute (AMI). Meatpacking industry earnings fluctuated relatively widely during the 1980s but show no evidence of consistently increasing over time, especially as concentration has increased in cattle slaughter. One limitation of the AMI earnings data is that earnings are averaged across firms voluntarily responding to the AMI survey. Whether or not the largest firms are included in the published data is not known. Conceivably, if the larger firms have exercised market power in conjunction with technical efficiency gains, a volume-weighted net earnings series might differ significantly from a simple average of all firms.

*Forbes* magazine also publishes financial data on the meatpacking industry. Reported return on equity data for the years 1974 to 1986 were presented in Ward 1988. *Forbes* data updated through 1988 are shown in Figure 9. No evidence exists that meatpacking profit rates increased along with concentration. Two comments about the *Forbes* data should be noted. First, only a few meatpacking firms are included each year in the *Forbes* report and the individual firms vary from year to year. Second, poultry processors are included with meatpacking firms. Excluding poultry processors from the meatpacking group would likely lower meatpacking returns compared with those shown in Figure 9.

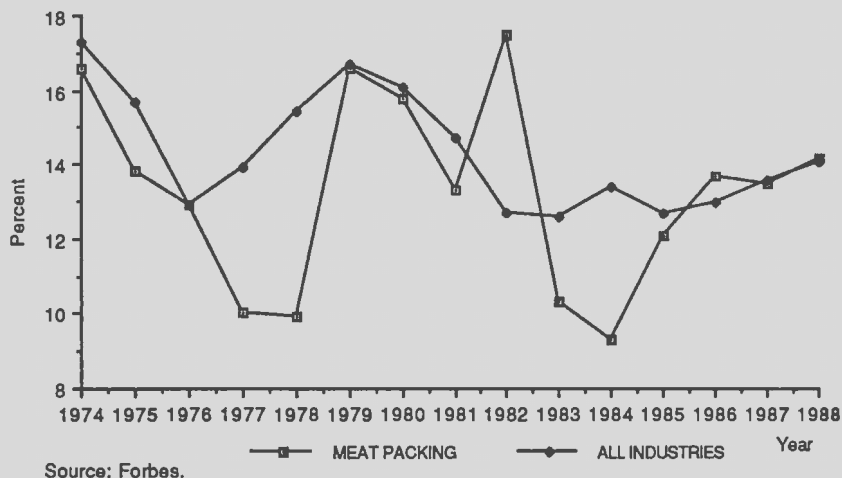
**Figure 7. Farm-to-Carcass Price Spreads for Beef and Farm-to-Wholesale Price Spreads for Pork, 1972 to 1988.**



**Figure 8. Net Earnings as a Percent of Sales in Meatpacking, Selected Species, 1979 to 1987.**



**Figure 9. Percent Return on Equity In Meatpacking and All Industries, 1974 to 1988.**



Some economists and observers argue that firms slaughtering steers and heifers have not capitalized on their ability to exercise market power because fed cattle supplies have been tight relative to slaughtering capacity. A study I conducted (Ward 1990a) found that excess slaughtering capacity existed for all livestock species and for boxed beef production in 1988. How capacity is defined determines to a considerable extent the degree of excess capacity. For example, I estimated excess capacity based on a per hour and per week basis. Unutilized or excess capacity was typically greater for smaller versus larger plants within each species. Even for the largest size plants, excess capacity per hour ranged from 4.8 percent for steers and heifers to 18.5 percent for slaughter lambs. On a per-week basis for the largest size plants, unutilized or excess capacity ranged from 36.7 percent for cows and bulls to 43.5 percent for slaughter lambs. The argument is proposed that when livestock supplies increase relative to slaughtering capacity, the Big 3 or some small number of firms will begin exercising market power.

**There is no compelling evidence to date that large meatpackers are earning excessive profits. Whether the relatively tight supplies of slaughter cattle are blocking any ability of large beefpackers to increase**

profits is an hypothesis that needs to be tested. In the presence of substantial excess processing capacity, it is possible that the large firms are having to compete for the available cattle.

## Price Discovery Research

Fewer firms have led to increased concentration in local and regional market areas, and reduced bids per sale lot. Captive supplies have increased, potentially contributing to pronounced within-week buying patterns and to the existence of more days between purchase and delivery of fed cattle. The question remains whether or not changes in structure and procurement practices have adversely affected the price discovery process.

Menkhaus, et al. attempted to determine whether or not number of buyers and packer feeding affected slaughter lamb prices. Four of the five largest sheep and lamb slaughtering states, which represented 65 percent of 1985 U.S. sheep and lamb slaughter, were chosen for study. The analysis used annual data for the 1972-to-1985 period. In one of four states, there was evidence that increased buyer numbers significantly improved slaughter lamb prices. However, the authors admit the number of buyers in that state declined sharply over the study period, and the variable for number of buyers may have explained variation from an omitted factor which also exhibited a sharp downward trend. For the remaining three states, number of buyers did not significantly affect slaughter lamb prices. In one of the three states, number of buyers ranged from one to three during some years over the study period. Slaughter lamb prices were enhanced in that state when number of buyers exceeded one, suggesting that buyer competition and price are positively related.

Packer feeding was hypothesized to be negatively related to slaughter lamb prices in Menkhaus, et al. However, in three of the four states packer feeding was found to significantly improve slaughter lamb prices. Packer feeding of lambs may ensure a supply of lambs for slaughter during seasonally low-supply periods or smooth the flow of lamb marketings for slaughter, rather than simply add flexibility in lamb procurement and pricing. Whether or not packer feeding adversely affected short-period (within-week or week-to-week) slaughter lamb prices was not addressed in the Menkhaus, et al. study.

Koontz, et al. examined direct price data collected by Agricultural Marketing Service (AMS), U.S. Department of Agriculture market reporters for selected cattle feeding and slaughtering regions. They found evidence that meatpackers behaved "cooperatively" in some regions during the two

periods studied, June 1980 to June 1982 and June 1984 to June 1986. Cooperative behavior was associated with relative price stability and appeared stronger during the most recent period, which corresponded to higher buyer concentration for fed cattle. One implication from the Koontz, et al. study is that some degree of tacit collusion existed among packers in fed cattle procurement during the periods and in the regions studied. However, other reasons may explain reduced price variability and the appearance of cooperative behavior. For example, as smaller slaughtering plants close and larger plants more nearly equalize in terms of slaughter rate and level, the expected variation in per head slaughtering costs among plants also declines. Reduced slaughter cost variation could contribute to reduced bid and price variation.

Data collected from feedlots during July 1979 and again in June 1989 allowed the study of various aspects of the price discovery process for fed cattle. Regression results on the 1979 data confirmed that futures market prices and carcass beef prices explained the variation in fed cattle prices (Ward 1988). Regression analysis on 1989 data found similar results.<sup>25</sup> In some regression equations on the 1989 data, boxed beef cutout prices were substituted for carcass beef prices.<sup>26</sup> Results were mixed. In one-half of the region-sex equations, using boxed beef cutout prices improved the explanatory power of the model, but in the other half, carcass beef prices explained more of the variation in fed cattle prices.

Whether or not boxed beef cutout and carcass beef prices are equally related to fed cattle prices is important for price discovery. In late 1989, IBP announced its support to eliminate any moves to carcass price reporting. AMS has for many years recognized the thinness of reported carcass beef prices, and there is reason to believe AMS will cease carcass price reporting sometime in 1990. In the past, carcass prices have served as a starting point for packers and feeders in estimating bid prices for fed cattle (Ward 1988). Without carcass prices, cattle feeders question what can be used as a reliable substitute (NCA Beef Industry Concentration/Integration Task Force).

Average daily fed steer and heifer prices from reported sales by respondent feedlots were tested for their correlation with three price series: (1) closing live cattle futures market prices; (2) boxed beef cutout prices re-

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<sup>25</sup> Analysis of the 1989 data continues, so results reported here should be considered preliminary.

<sup>26</sup> Six region-sex equations were estimated (steer and heifer equations for Southwest Kansas, North Texas High Plains, and South Texas High Plains) for the four full weeks of June 1989. Data limitations precluded estimating regression equations for Northeast Colorado.



ported by AMS; and (3) carcass beef prices reported by AMS. Table 11 shows correlation coefficients between selected price series for June 1989. Figure 10 graphically depicts selected price series relationships. The correlation between fed cattle prices and either boxed beef cutout, carcass beef, or live cattle futures market prices were not as high as they appear to be graphically. Fed steer and heifer prices for June 1989 were less highly correlated with both carcass beef and live cattle futures market prices than in July 1979. Boxed beef cutout prices were only slightly more correlated with fed steer and heifer prices than carcass beef prices. Based on the above, it appears boxed beef cutout prices offer little improvement over carcass beef prices as a basis for estimating fed cattle bids and prices. Similarly, tying fed cattle prices to live cattle futures market prices may not provide a better means of discovering fed cattle prices. However, a one-month period may be too short to draw conclusive inferences.

Regression analyses on the 1979 data indicated that in one of four region-sex equations, number of buyers bidding on fed cattle increased prices paid to feeders, after accounting for other factors affecting fed cattle prices (Ward 1988). In the other three equations, there was no significant relationship between number of buyers bidding on cattle and fed cattle prices. Regression analyses also indicated that while there were significant differences in prices paid to feeders by packers, price differences were not related to meatpacker size, as measured by market share of purchases.

Similar analyses were conducted on the 1989 data. Conceptually, number of buyers bidding on livestock would be expected to be positively associated with higher prices paid by buyers. A variable for number of bids from different packers was positive and significant in just one of six region-sex equations. Therefore, there was no strong evidence that number of bids significantly affected fed cattle prices. Number of bids from different packers ranged from just one to four, thus varying relatively little and potentially explaining why the variable was not significant in the regression equations.

Significant differences were found among prices paid by buyers for fed cattle in some region-sex equations for June 1989, similar to findings ten years earlier (Ward 1988). Significant differences were also found among prices paid by buyers in daily models across regions and in weekly models within regions. However, no consistency was evident and no explanation for the differences was apparent.

Boxed beef cutout prices and carcass beef prices did not exhibit a strong within-week pattern over the four weeks of June 1989. However, signif-

**Table 11. Correlation Between Fed Cattle Prices, Live Cattle Futures Market Prices, Boxed Beef Cutout Prices, and Beef Carcass Prices, June 1989.**

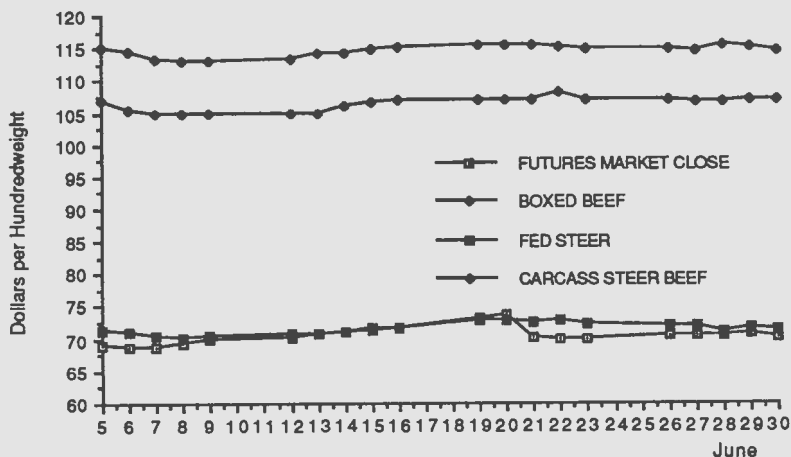
Price Series	Time	Average Daily Steer Price	Average Daily Heifer Price
(Correlation Coefficient)			
Boxed Beef Cutout	Same Day <sup>1</sup>	.782	.740
	Previous Day <sup>2</sup>	.600	.556
Carcass Steer	Same Day	.629	—
	Previous Day	.497	—
Carcass Heifer	Same Day	—	.634
	Previous Day	—	.628
Live Cattle Futures Close	Same Day	.539	.534
	Previous Day	.673	.735

<sup>1</sup> Same day refers to boxed beef cutout, carcass steer and heifer, and live cattle futures closing prices in day t compared with average daily steer and heifer prices in day t.

<sup>2</sup> Previous day refers to boxed beef cutout, carcass steer and heifer, and live cattle futures closing prices in day t-1 compared with average daily steer and heifer prices in day t.

icant differences were found in day-to-day prices for fed cattle. Using Monday as the base day, prices were significantly lower in: (1) five of the six region-sex equations for Tuesday; (2) one equation for Wednesday; (3) one equation for Thursday; and (4) three equations for Friday. In one equation for Thursday, fed cattle prices were significantly higher than for fed cattle prices on Monday. The regression models analyzed data from the three southernmost regions (Southwest Kansas, North Texas High Plains, and South Texas High Plains). In those regions, buyer activity was greatest on Monday where "activity" was defined by combining buy-

**Figure 10. Fed Steer, Live Cattle Futures, Boxed Beef, and Carcass Steer Price Relationships, June 1989.**



ers in the feedlot with buyers actively bidding. However, Tuesday was the day in which respondent feedlots reported the highest percentage of buyers actively bidding, yet fed cattle prices were significantly lower than Monday. For Wednesday, Thursday, and Friday, the percentage of feedlots reporting no buyer activity increased, and lower prices were observed in some cases. Results provide limited evidence of a positive relationship between buyer activity and price.

One question not addressed in previous research was whether or not captive supplies significantly affected fed cattle prices. The extent of captive supplies by packers purchasing fed cattle from respondent feedlots was significant. One attempt to explain fed cattle prices by including a captive supply variable in a regression model indicated captive supplies had no significant affect on individual fed cattle prices during June 1989, despite relatively high levels of captive supplies. The variable created was the percent of captive supplies shipped for slaughter the three days prior to the day sale prices were discovered. Determining whether or not captive supplies affected fed cattle prices is difficult. More research is necessary to determine the appropriate time period prior to the day or week in which prices are discovered to measure captive supplies. Results of the limited analysis here do not document the existence of price differentials

suggested by Wayne Purcell's conceptual development in Chapter 1. But the results could change as we progress in understanding of the issues and in knowing how to model the "captive supply" variable.

**There is no clear empirical evidence that suggests the reduced number of buyers and related reductions in buying activity cause fed cattle prices to be lower. More extensive analysis is needed, and there is a need to focus on the overall level of prices rather than just the day-to-day or sale-to-sale variability in prices.**

## *Policy Alternatives, Direction, and Research Needs*

The industry initiatives section above provides evidence of increased concern among livestock producers and feeders regarding concentration, integration, and price discovery. Speculation continues that Congress will conduct hearings on these issues in 1990. Two questions surface most frequently. The first is how serious impacts from structural changes might be.

The evidence that concentration in meatpacking, especially in steer and heifer slaughter, boxed beef production, and sheep and lamb slaughter, has increased sharply is clear. The evidence that captive supplies have increased sharply for fed cattle and are at relatively high levels for slaughter lambs is also clear. If left unchecked, further consolidation, concentration, and integration, including increased captive supplies are probable.

Unfortunately, the evidence regarding impacts from structural and behavioral changes is not clear. Research and available information presented in Ward (1988) and in this chapter provides inconclusive evidence that concentration and integration have significantly and adversely affected the livestock-meat subsector. Clearly, there are fewer buyers in local markets, less bidding per sale lot, days in which even the largest cattle feedlots experience no buying activity, and fewer publicly-available livestock and meat prices to report and on which to base price. But whether or not prices and price discovery have been adversely impacted is not clear. Price discovery has changed, but perhaps has not been adversely affected.

There are positive impacts from increased efficiency in meatpacking which must be recognized. This point was extensively developed in Chapter 1. Those efficiencies have likely been translated into higher prices paid for

livestock or lower prices charged for meat. And there is no evidence that meatpacking industry profit rates have increased as consolidation and concentration increased. The red meat complex might not be as competitive with alternative meats as it is currently if consolidation, concentration, and integration had not occurred.

The second question, then, is what should be done about concentration, integration, and price discovery? Below are some thoughts on alternative public policies.

## **Policy Alternatives**

Several policy alternatives were identified in Ward (1987): (1) more strictly enforce antitrust legislation; (2) increase surveillance and monitoring efforts by regulatory agencies, especially P&SA; (3) enact new and more restrictive antitrust legislation; (4) mandate electronic trading of livestock and/or meat; (5) organize livestock marketing cooperatives and possibly mandate that packers bargain with those cooperatives for livestock supplies; (6) eliminate specific pricing methods such as forward contracting or formula pricing; (7) require price reporting of livestock and meat transactions; and (8) delist livestock and meat futures market contracts.

Recommendations stemming from industry initiatives discussed above, such as the NCA Task Force on Concentration/Integration, focus most on the following alternatives: (1) more strictly enforce antitrust legislation, especially disallowing further mergers involving the Big 3 beefpacking firms; (2) increase surveillance and monitoring of structural changes and impacts; (3) organize cooperative marketing efforts when they seem appropriate; and (4) encourage (not require) reporting of captive supplies and market prices. Industry reports also encourage further research.

## **Policy Direction**

At a meeting of several livestock trade organizations sponsored by the AFBF, an agreement was reached encouraging appropriate officials in USDA and the Antitrust Division of the Department of Justice (DOJ) to reach an agreement allowing P&SA to become involved in merger decisions involving meatpacking firms. Current legislation specifies that only the Federal Trade Commission (FTC) and DOJ rule on proposed mergers. Currently, P&SA is relegated to an advisory status, at best, in merg-

ers involving meatpacking industry firms. I support reaching and making public a definitive agreement between the affected Federal agencies regarding P&SA's decision making authority in rulings on future proposed mergers involving meatpacking firms.

P&SA has increased its market surveillance activity since the series of mergers in 1987 which created the Big 3 meatpackers. The captive supply study discussed above represents an effort to develop better information on the extent of captive supplies for fed cattle, thereby supplementing their on-going data collection efforts regarding packer feeding. P&SA's principal surveillance thrust involves developing an ARIMA model of historical prices from which to forecast weekly average prices. Actual reported prices are regularly compared with forecasted prices. When large deviations occur between forecasted and observed prices, other information is sought to explain discrepancies. Efforts, such as the one by P&SA, to surveil or monitor the marketplace are encouraged. Regulatory agencies need to be in a position to act promptly when (if) noticeable and persistent problems appear.

Increased monitoring of forward contracting, and presumably captive supplies generally, is supported by cattle feeders. The forward contracting survey conducted by Ward and Bliss solicited reactions from cattle feeders regarding alternative policies targeting increased forward contracting. The most supported policy alternative was for industry groups to monitor the extent of forward contracting. And in recent years, Cattle-Fax, Texas Cattle Feeders Association, and other industry organizations have increased their efforts to collect information on the amount of forward contracting. Likewise, AMS reports forward contracting volume. The second most-preferred alternative was mandatory contract reporting to an industry group, though it was less favored by larger feedlots than smaller ones. Larger feedlots preferred voluntary contracting reporting.

**The importance of clearly defined and effective policy positions has increased with consolidation of the industry. A 5-point move in the concentration ratio from 75 to 80 may not have the same implications as a 5-point move from 45 to 50. The dialogue in 1990 needs to address whether policies of the 1980s meet the needs of the 1990s.**

## **Research Needs**

Three principal avenues of research are identified here. One of the primary needs is continued study of potential impacts from structural and

behavioral changes. Cattle feeder perspectives on potential impacts from forward contracting were negative (Ward and Bliss). Similarly, livestock producer and feeder concerns suggest that perceived impacts from concentration and captive supplies (in addition to forward contracting) are also negative. Yet, research reported here and elsewhere found no consistent evidence of adverse impacts on fed cattle prices. More refined research techniques and better data may be needed. If no adverse impacts are found, research results can help dispel growing concerns by livestock producers and feeders about competition and pricing problems. Conversely, if adverse impacts are found, necessary corrective action targeting the problem can be formulated.

A second avenue of research is on market surveillance and monitoring tools and techniques for regulatory agencies. P&SA and the Antitrust Division of the DOJ use concentration ratios (CR) and the Hirschman-Herfindahl index (HHI) as indicators of market power. However, neither accounts for vertical integration, which may significantly affect buyer competitiveness in within-week and between-week price discovery.

The concentration ratio is computed by

$$(1) CR_m = \sum_{i=1}^m MS_i$$

where CR is the concentration ratio and MS is the percentage market share of the  $i^{th}$  firm. Concentration ratios are typically computed for the 4, 8, 12, or 20 largest firms in an industry. Concentration ratios are expressed in percentages and can range from 1 to 100 with smaller values preferred to larger ones.

The Hirschman-Herfindahl index is computed by

$$(2) HHI = \sum_{i=1}^n MS_i^2$$

where MS is the percentage market share of the  $i^{th}$  firm. The Hirschman-Herfindahl index ranges from 1 to 10,000. As is the case with

concentration ratios, analysts and the regulatory agencies would tend to prefer small values of HHI to larger ones.<sup>27</sup>

A potential measure of market power which incorporates the vertical and horizontal market dimension is a measure I have called the "competition index" (Ward 1990b). The competition index is computed by

$$(3) \text{ CI} = \frac{\sum_{i=1}^n (MS_i^2)(CS_i)}{1,000}$$

where CI is the competition index, MS is the percentage market share of the  $i^{\text{th}}$  firm, and CS is the percentage captive supplies for the  $i^{\text{th}}$  firm. The competition index ranges from 1 to 1,000 with smaller values generally preferred to larger ones. The competition index declines as: (1) number of buyers increases; (2) market shares of the largest firms decrease; (3) variance of market shares among the  $n$  firms decreases; and (4) captive supplies of the largest firms decrease. The competition index is essentially a Hirschman-Herfindahl index weighted by the extent of captive supplies for each firm.

Data collected from cattle feedlots during the four full weeks of June 1989 are used to illustrate the competition index. Table 12 shows the competition index compared with the four-firm concentration ratio and the Hirschman-Herfindahl index for the same regions and period. Southwest Kansas had the lowest competition index and, according to the competition index, the highest degree of buyer competition for fed cattle. Three of the four buyers had similar market shares of shipments. While one firm had large captive supplies, it had a relatively small market share of shipments. The competition index was much higher for the two Texas High Plains regions despite the fact there were more buyers in each region compared with Southwest Kansas. In both Texas High Plains regions, firms with the largest market share of shipments also had the highest percent captive supplies. The additional buyers in both Texas High Plains

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<sup>27</sup> The issue of which levels should be "preferred" is not a simple one. In Chapter 1 and again in this chapter, the issue of tradeoffs between the efficiencies of large size and the market power that comes with large size was raised. It is theoretically possible, for example, that society (producers, consumers, etc.) is better served by an industry with a concentration ratio of 50 than one with a concentration ratio of 25.



regions were small and relatively unimportant, thereby contributing relatively little to the competitive environment.

The above example illustrates one possible tool which might assist regulatory agencies in their surveillance and monitoring activities. But more research is needed, both regarding the proposed competition index and alternative surveillance and monitoring tools and techniques.

A third avenue of research involves developing a price series which can be used in price discovery when carcass price reporting ceases. Significant improvement must be made in the boxed beef cutout series or new wholesale and/or retail beef series need to be developed. AMS began using a new boxed beef cutout formula in January 1990 which may provide a better series from which to estimate fed cattle prices. Fed cattle prices may increasingly be priced off live cattle futures market prices rather than wholesale beef prices, if no adequate replacement for carcass prices is found. Therefore, research is needed to ensure that futures market contracts and related trading practices are representative of and appropriate to industry conditions. Likewise, continued surveillance and monitoring of futures market trading is needed to ensure futures market price discovery remains competitive.

**It is always seen as self-serving for a researcher to call for more research, but more work is clearly needed. Our current models may not "fit" the situation of the 1990s, and progress is needed in both conceptual development and in empirical analyses.**

## *Concluding Remarks*

Typically there are trade-offs between technical efficiency gains (such as lower costs in slaughtering and processing) and pricing efficiency losses (such as reduced competition in livestock procurement or meat sales) associated with industry consolidation, concentration, and integration. Likewise, there are trade-offs between the status quo (such as allowing the industry to evolve unchecked) and alternative corrective action when deemed necessary (such as antitrust litigation). Only when the problem becomes sufficiently serious will alternatives be considered and costs estimated for those alternatives.

Nicholls, in a 1940 article, argued that market-sharing among packers had persisted for 40-50 years, perhaps adversely affecting livestock and meat prices (Nicholls). However, he concluded: "Only after considerable fur-

**Table 12. Comparison of the Competition Index with Other Market Power Measures in Fed Cattle Procurement, by Region, June 1989.**

Region	Packer	Percent Market Share of Shipments	Percent Captive Supplies	Market Power Measures		
				4-Firm Concentration Ratio (Percent)	Hirschman-Herfindahl Index	Competition Index
Southwest Kansas	IBP	29.5	24.3	-	-	-
	ConAgra	27.2	2.4	-	-	-
	Excel	7.0	60.1	-	-	-
	National Beef	30.2	0.0	-	-	-
	High Plains Dressed Beef	6.0	45.1	-	-	-
	Region Total	99.9 <sup>1</sup>	NA	93.9	2607.1	27.6
North Texas High Plains	IBP	38.4	55.7	-	-	-
	ConAgra	11.0	2.2	-	-	-
	Excel	33.5	72.9	-	-	-
	National Beef	13.9	3.0	-	-	-
	Booker Packing	3.2	33.8	-	-	-
	Region Total	100.0	NA	96.8	2921.3	165.1
South Texas High Plains	IBP	5.4	31.7	-	-	-
	ConAgra	20.6	56.3	-	-	-
	Excel	71.5	43.4	-	-	-
	High Plains Dressed Beef	.1	0.0	-	-	-
	Cloviss Packing	.1	0.0	-	-	-
	Caviness Packing	1.4	0.0	-	-	-
	John Morrell	.7	48.6	-	-	-
	Handy Packing	.2	0.0	-	-	-
	Region Total	100.0	NA	98.9	5568.3	246.7

<sup>1</sup> Total does not equal 100 due to rounding.

ther investigation will we know whether or not reform in the packing industry is necessary. It is conceivable that such monopoly elements as exist yield desirable results. A less extreme possibility is that results are undesirable but not sufficiently bad to bother about." (Nicholls, p. 240).

Evidence of technical efficiency gains in meatpacking are more clear than are the losses associated with reduced competition and implications to pricing efficiency. Research attempting to determine and measure pricing efficiency losses has produced mixed results. Clearly, more research is

needed to fully answer the question of whether or not consolidation, concentration, and integration have already, or will in the future, lead to poor economic performance. A limitation related to continued research, and similarly for market surveillance, is that research and surveillance are predominantly ex post in nature. By the time research or market surveillance identifies a problem, some degree of harm has been done and the circumstances that have evolved may be irreversible.

The affected industry participants, regulatory agencies, and researchers are less able to predict the magnitude of potential problems than is desirable. Consequently, even if a problem can be foreseen accurately, its magnitude can only be estimated with uncertainty. Consolidation, concentration, and integration concerns continue to mount. However, to date, specific policies addressing the issues do not appear to be widely accepted among those affected. And the cost-benefit trade-offs associated with alternative policies have not been estimated. In the meantime, consolidation, concentration, and integration proceed, perhaps reaching a point at some unknown time when pricing efficiency losses are both inevitable and greater than technical efficiency gains.

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# CHAPTER 3: LINKAGES BETWEEN PACKERS AND RETAILERS: MOTIVATIONS, PERSPECTIVES, AND IMPLICATIONS TO PRODUCERS

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## *Introduction*

Change has been the one constant in the beef sector during the past two decades. Consumer demand changes have been widely discussed and have impacted the sector in a number of ways. Concurrently, change in the packing industry has received increased attention -- as mergers and acquisitions have created a packing industry where four firms control 80 percent of some markets. The food distribution industry also experienced change during this period as new forms of retail outlets emerged and new information technologies such as scanners changed the scope of operations.

Amid these changes an ongoing dialogue emerged within the sector. Producers, industry analysts, and regulators expressed concern over the impacts of the new levels of concentration on competition within the sector.

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Packers and retailers stressed the need for consistent high-quality supply flows to meet the changing consumer demands. Consumers voiced their opinions through purchasing patterns -- making it clear that convenience and diet and health concerns are equally, perhaps more, important in the purchasing decision than price. The dialogue has not been calm. Indeed it has frequently been filled with biases and innuendo about who is doing what to whom and why they must be made to stop. But, the dialogue has been far less than information rich. Too little is known about operations at different levels in the system and the secrecy often induces adversarial posturing by people at different levels of the system -- people who are essentially all interested in providing a safe, high quality product to the consumer.

This chapter attempts to explore some of the reasons behind change in the beef sector in trying to look ahead and to the changes yet to come. The perspective throughout is that of taking a fresh look at some of the old problems which continue to plague the industry. Experience in the sector and awareness of the available literature were combined with the insight gleaned from phone surveys during 1989. The focus is both conceptual and descriptive. New perspectives from the world of business and finance are brought to bear upon the issues of linkages within the system. Limited empirical evidence is offered with regard to the impacts of changes within the sector on price. Unlike much of the previous work in this area, our focus is on the linkages between the packer and the retailer and their implications and impacts on the producer. It is hoped that this focus can contribute to a better informed discussion of the sector and better understanding of the changes which have and will continue to occur.

## *Background*

Competition in the beef processing sector has long been an area of concern. Throughout the decades of the 70s and 80s, discussions have focused on problems with thin markets, issues related to price reporting, and the impacts of increased consolidation in the packing industry on market performance. Within the past 18 months, two major efforts have been launched to examine the impacts of such changes on the industry: the NCA Concentration/Integration Task Force and the Competitive Issues Task Force. The reports of these two groups document the concerns and the specifics will not be repeated here. Instead, we will shift our attention to the perspectives inherent in such analyses of the industry and the limitations which those perspectives impose.

Discussions related to competitiveness in the beef sector are limited severely by the perspectives employed. While this is not meant to suggest or imply that the reports of either of the above task forces are errant in their conclusions, it is intended to suggest that the industry would benefit from a broader perspective. Specifically, there is a pressing need to consider the changes which are occurring in the beef production and marketing system in light of the economy-wide changes which are occurring -- especially within the food system.

**At the heart of the issue is concern that a limited number of players at any level in the system will possess enough power to exert influence over players at other levels of the system.**

The assumption out front is, therefore, that a few large packers can and will manipulate prices to the detriment of cattle feeders and feeder-stocker producers. The central issue becomes the pricing impacts of changes in concentration levels -- particularly impacts which arise from changes in procurement practices, such as the decline in the number of auction markets seen in the past two decades or the increased reliance on captive supplies which emerged in the late 1980s. Inherent in studies which draw on this assumption is the notion that the perfect competition model is the most desirable model for efficiency. This is not necessarily the case. Indeed, we submit that the major limitation of research efforts in this area is invoking the "perfect competition model" without regard to measuring and estimating the impacts of any efficiency loss associated with a less than perfectly competitive market. On a related dimension, the failure of such efforts to examine the behavioral dimensions of the imperfectly competitive markets being studied is troubling.

The previous statements clearly are generalizations which do not necessarily apply to all of the work which has been done, but they illustrate an important problem. The perspectives from which the issues facing the beef sector are examined and discussed influence the outcomes of the inquiries. Given that the core issue is one of how the beef sector can best compete and survive in the future, the perspective needs to change. Assuming that an imperfectly competitive world -- a world in which there are few market outlets for the producer and where captive supplies are important in day-to-day operations -- is harmful to those involved in the production of cattle is not an appropriate point of departure for examining the future of the industry.

Identifying this limitation created by perspective is unfortunately far simpler than correcting it. Those in the industry and those who study it have



been forced to work in an environment where information is limited. Unfortunately, the facts that the economy is difficult to model and that different players operate with different motives make analysis difficult. The information linkages between different levels of the production-marketing sector are historically weak, with information often differing significantly by market area. Changes in information technology during the 1990s may well offset the latter problem, however.

**Assuming a perfectly competitive market is the desired norm limits our analyses. The objective should be broad analysis to help the industry compete and survive in the future in a changed environment.**

## *Forces of Change*

The changes which we have witnessed in the beef production and marketing system have been attributed to a number of factors. The discussion surrounding the changes has at times seemed to suggest that some group within the system possessed and was carrying out a grand plan for change in the industry. This is not the case. In fact, the changes can be traced to two important developments -- *changes in consumer demand and changes in the structure of the food processing and distribution industries*. These changes are implicitly intertwined and defining a causal relationship between them is not possible. However, it is possible to better understand the future by briefly examining these changes and their potential impacts.

*Demographics* and their impacts on demand have been widely discussed in recent years. Dychtwald and Flower, in their book *Age Wave*, provide an interesting and insightful treatment of the issues we face over the next several decades as the baby boom generation approaches senior citizenship. The impacts of these demographics on the beef industry are widespread. First and foremost, an aging population demands different types of food -- being increasingly concerned about the diet and health aspects of the food they eat, consuming less total food, and seeking convenience in preparation and consumption (evidenced either through preferences for more convenient products or through increased eating away from home). But changes in demand are not the only impact of the age wave phenomenon on the beef industry. As the industry has matured, investment opportunities have been viewed in a different manner. A mature or declining industry is not an attractive investment. This directly affects the beef industry through changes in the ownership and control of packing firms and commercial feedlots. Although these impacts are less observa-

ble and difficult to measure, they are important in the evolving industry structure.

Changes within the food processing sector also have impacted the beef industry in the past two decades. In responding to the new consumer described in the preceding paragraph, the food processing industry has evolved into a bi-modal sector with a few very large firms focusing on commodity processing and a number of smaller firms focusing on further processing (sometimes referred to as value-added processing). These changes in the food processing sector have been accompanied by changes in the retailing of food -- again in response to demographics. In recent years the role of the convenience store has been greatly expanded, with many of these stores now having deli sections and selling further-processed meat products. We also have witnessed the advent of the warehouse super store, a store where fresh meat often is not sold and the bulk of meat sales are in the form of frozen and processed products. And, as consumers became more interested in convenience and more concerned about diet and health, the supermarket lost its ability to utilize meat to draw customers into the store. While this generalization may not be true for all consumers, the evidence (such as that gathered by the National Livestock and Meat Board) suggests that the group of consumers who are price sensitive and primarily shop the fresh meat case has continued to decline in recent years. It is worth noting here that the buying habits of consumers are likely to change even more in the next decade. Systems already are available for shopping for groceries at home, using a computer terminal and a telephone hook-up. As more consumers seek to reduce their time commitment to this activity, acceptance of new forms of products will increase. For example, the concern about the color of case ready beef products may diminish as the consumer trades the convenience of shopping at home for the ability to handle the product prior to purchase.

The above illustrations suggest that the beef sector has seen structural change on two fronts, consumer demand and food processing. These structural changes have filtered through the production and marketing system to dramatically impact operations at every level. It is worth noting that these changes have just begun and that the long run impacts on the sector perhaps will be even more dramatic than the changes to date. As the further processing sector becomes more prevalent, the demand for meat which the packer sees will change. The emphasis from some of the value-added processors will be on specific cuts with specific levels of quality, depending upon the ultimate use. At the same time, other value-added processors may become less concerned with quality and more

interested in supply flows. Either posture by value-added processors will require changes by the packer. These changes will be manifested through an increased effort by the packer to lock up supplies to be able to meet the demands of the value-added processors. Thus long term purchase agreements, forward contracts, and other procurement strategies and the related "captive supplies" will be relied on more in the future.

This discussion may seem to suggest that the packing and/or processing sectors will move towards integration, perhaps even integrating back to the feeding level. We argue that this will not be the case. Although that strategy has worked very successfully in the poultry industry, it is not likely to be needed or desirable in the beef industry. The primary reason this will not occur is information technology. As we see continued developments in information technology, the very real potential emerges for coordination within the production and marketing system without ownership. The packer will not have the need to enter the cattle feeding business because the information can be shared readily between different levels of the system.

Consider, for example, the use of scanners and other computerized inventory tracking systems in retail food outlets and the potential they offer for efficiently reacting to consumer needs. By tracking the purchases of customers, the store is able to better schedule delivery of stock. Orders will be based on the types of products, brands, and package sizes which the customers purchase. This will impact the beef sector as different retail outlets gain better insight into the purchasing patterns of consumers with regard to meat and meat products. Once the retailer has this information, it can be shared with the wholesale and processing levels to better align what is being produced with what is being sold. The information also can be used to send a signal to the packer and to the producer with regard to the types of inputs needed for processing.

**The system thus is coordinated vertically to satisfy consumer demands without integration through ownership. The coordination occurs through the sharing of information. It should not be difficult to imagine how the process could work as information about products essentially supplements, perhaps replaces at some levels of the system, price as the coordinating mechanism along the production and marketing continuum.**

## *New Perspectives on the old Problems*

The common thread running in the above discussion is the need for a new perspective for research and discussion of the challenges facing the beef production and marketing system. In this section we define such a perspective drawing on concepts from a number of areas. An emerging view of the food system is presented to illustrate the types of economy-wide changes which are impacting the beef sector. Next, the concept of business performance is used to illustrate how changes in ownership may impact structure and change the role of production within the system. A discussion of competition and markets is offered to illustrate the motivations for changes which are occurring. Finally, the potential costs of increasing competition are considered briefly.

### **An Emerging Perspective on the Food System**

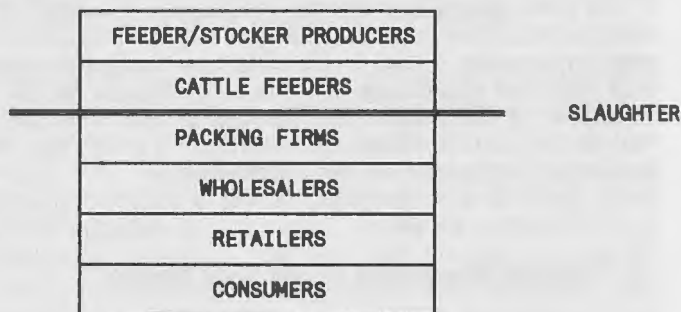
The food system historically has been characterized by a number of differentiated and independently operated levels with each adding value to the final product. This view of the beef sector is depicted in Figure 1. The sector is essentially composed of two segments: the production subsector and the processing/distribution subsector (sometimes referred to as the food manufacturing industry). Although not drawn to scale, the height of each box in the diagram can be viewed as representing the contribution margin of each level of the system, the amount each level contributes to the value of the final product which the consumer purchases.<sup>2</sup>

There two important features to note in Figure 1: 1) the slaughter line serves as a demarcation between the production subsector and the processing subsector, and 2) solid lines divide activities at each level of the system. In this traditional view of the food system, the producer performs a key function, contributing the final step in the production process by moving live cattle into the processing subsector via transfer to the packer. Since the packer is assuming responsibility as the first step in the processing subsector, the producer can ignore the subsequent steps in the system, i.e., wholesaling, retailing, and the final consumer.

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<sup>2</sup> The material in this section draws heavily on Hudson, M. A., "Towards a Framework for Examining Agribusiness Competitiveness," *Agribusiness: An International Journal*, 6(1990) (in press).

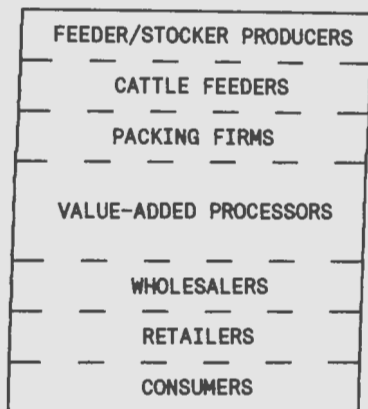
**FIGURE 1. A TRADITIONAL VIEW OF THE BEEF PRODUCTION AND MARKETING SYSTEM.**



This traditional perspective served the beef sector well throughout the growth period of the 1950s, 1960s, and early 1970s. But late in the 1970s, the beef system dramatically changed. The primary driving force for change was the maturity of the market for beef and the increasing sophistication of the consumer. No longer was it enough for the system to provide a consistent flow of fresh beef into the retail case. Consumers began to demand more convenience in the beef they consumed and their increased concern about diet and health led to a preference for more closely trimmed and further processed products. As noted earlier and stressed by Wayne Purcell in Chapter 1, concurrent with these consumer changes came changes in processing and distribution of beef.

As a result, the system itself changed. Figure 2 depicts the beef system as it appears today. Three key differences can be seen in this diagram of the emerging beef system: 1) the slaughter line has disappeared, there is no longer a clear demarcation between production and processing activities, 2) the solid lines between each level of the system have been replaced by broken lines, as specialization and independence of operations at different levels of the system has become less clear, and 3) the value-added processing level has emerged as a major element of the system with the relative size of the box representing this area (though not drawn to scale) reflecting the amount of value being added to the product by this level of the system.

**FIGURE 2. AN EMERGING VIEW OF THE BEEF PRODUCTION AND MARKETING SYSTEM.**



The above view of the beef production and marketing system for beef has a number of implications. First, the system is now much more focused on the consumer. Activities at each level are geared towards satisfaction of the consumer. Second, the lack of clear lines between the different levels of the system opens the door for increased cooperation between producers and packers, packers and further processors, and processors and retailers. When considered in conjunction with the increased consolidation of the packing industry and the emergence of new forms of operations at the retail food distribution level, the possibility of further changes in the next decade becomes readily apparent, particularly when the changes in information technology noted above are considered. It is quite possible that this new beef system will increasingly move towards vertical coordination through the sharing of information. The implications of such a move are far reaching. Consider, for example, a value-added processor selling a product which requires especially high quality cuts of beef. The processor can work with the wholesaler (who has access to information from the retail level) to gain a better assessment of the demand for the product, perhaps through a test market. This information

can then be used to work with a packer to secure the quality and quantity of beef needed to create a product which meets the consumers needs. It is not difficult to imagine that the packer will then work back to the producer, using the information obtained from the other levels of the sector in an effort to stimulate production of the right type of product.

**The result, as noted above, is that information becomes equally important to price as a means of coordinating activity within the system.**

Before leaving this discussion of the beef system, it is important to note that the view presented here is not new. The perspective of the production and marketing system and the need for (and role of) coordination has been a recurring topic of discussion in the literature, including Connor, et al., Goldberg, Handy and Padberg, Mighell and Jones, Schrader, et al., Shaffer (1968), Shaffer (1980), and others. Despite this continued attention to the concept, the research community continues to ignore the perspective in examining the sector, further contributing to the problems of limited information noted above.

## **A Business Performance Perspective**

Increased attention to vertical relationships as described above leads to a need for a new view of performance within the beef production and marketing sector. Firms involved with multiple levels of the system begin to work together in improving the efficiency of the production and marketing process. Involvement in the sector thus becomes analogous to a portfolio selection problem, a search among alternative business ventures with a goal of achieving a desired rate of return consistent with the risks borne.

In addition to evaluating the individual business segment, we need to consider the performance of the mechanisms of linkage to other levels in the system. As the relationships between the components in the system become more prominent the performances of the linkages becomes as important as the performance of the components. The increased need to recognize "inter-level" interactions also blurs the focus of single level organizations and generates an amoeba-like search of potential business portfolios as available capital seeks its most productive employment. That is, the business center, whether nearer the production, packing or retail level, is faced with a capital allocation problem that is less confined to typical "local" activities than in days past. Here, there are critical distinctions between investing and ownership or control that deserve further exposition. For example, even if ownership of a particular commodity

were an end goal, the quantity that can be owned will be maximized by first investing the capital it represents in the form that generates the highest rate of return and later converting back to the asset desired.

The problem thus is one of locating and assembling the mix of assets that generate the desired risk-reward characteristics rather than of attempting to alter the returns distribution for the particular assets controlled. Unfortunately, for many producers in particular, this concept is difficult to internalize and implement. However, the relative ease of using futures markets and the ability to access information has lowered the barriers to implementation of such strategies. The search for the appropriate mix of assets may indicate that dramatic restructuring of the investments held is needed, for example indicating that a producer should be short his commodity. Still the notion that one should be short the commodity they are now producing is to some an alien notion. As Thurman points out, "Agricultural producers are not necessarily long in the commodities they produce, and their end goal is not consumption of those products". Analysis of the production-retail continuum must recognize that the common denominator is the dollar rather than the commodity. Simply stated, a dollar is a dollar and business is business. No particular distinctions are granted the sector because of the underlying commodity being transformed. Too many efforts have focused on commodity-own rates of return, the rate at which a commodity today may be transferred into a commodity in the future ignoring the relative rates of return available to the capital at stake. Below, we present further implications from viewing production decisions separately from the "investment" decisions.

A further reorientation in thinking involves the level at which production decisions are made. Clearly, quantity production decisions should not be viewed as exogenous to the system, but rather are a result of derived demand from a complex array of final products. We suggest, therefore, that it may be more appropriate to focus attention and effort on facilitating "efficient investments" rather than on combating production signals that get relayed in the form of an unwelcome price. Taken to an extreme, it could be argued that the additional investment involved in stimulating final demand generates only a possible return to the activities of generating demand rather than additional return to production. As with a other aspects, these activities may be properly viewed as being among the available investments for employable capital. The charge of the market participant remains that of locating and assembling the set of investment activities that combine to form the optimal portfolio allowing for the linkages, (synergies and competitions) among the components. It is important to recognize that capital is by-and-large committed on the basis



of the asset's contribution to the portfolio's return rather than in isolation from other assets. For many, a set of production activities represents just such a portfolio, but for others, the capital may have more productive uses.

**Production decisions are important to the total system, but should not be made in isolation. Production is part of a broader systems effort that ranges from the producer to the consumer. Increasingly, the entire system will be coordinated and investments will flow toward that part of the system that makes important contributions to the overall system objective of meeting consumer demands and expanding consumer markets.**

## **Competition and Markets**

Much attention has been given to the concern over the loss of competitive forces in the increasingly concentrated livestock markets. The structural changes have surfaced as reductions in the number of buyers bidding for animals, lack of clear price signals and a growing distrust of packers by producers and some retailers. Many producer debates begin with assertions to the effect that less competition results in lower prices for the cattle and higher prices for boxed beef. While admitting that economies of scale may naturally lead to larger and fewer buyers, and that the theoretical benefit of increased overall efficiency should be shared by all, many producers believe that they are at times disadvantaged by the changing structure of the market. We maintain, however that the reduction in buyers does not per se imply a reduction in the bid price. As Wayne Purcell suggests in Chapter 1, the efficiencies granted by streamlining the procurement process may actually lead to higher bid prices for the animals. Further, if the returns to an activity are in some sense "too low" then the ideal strategy is to "short" that activity and invest the proceeds in the other set of activities that caused the returns to be "too low". If in fact the average cost curves indicate significant economies of size and dictate a market with a few participants, the outcome in terms of cattle bid prices will be the same or better than in a more widely distributed structure so long as the initial competition for the market can take place in an economically efficient manner.

This discussion suggests a gradual movement in the center of competition away from the feedlot or point of purchase and toward the boardroom. If a packer were earning "too high" a rate of return, they would be subject to competition or dilution. Competitive pressures may be in the form of regulatory threat, takeovers, sell-offs, etc. For a large company, the packer function is just another investment prospective for the employment

of capital. The genesis of the industry has led to a structure where competition "for" the market is at times more evident and possibly more important than competition "in" the market. Note again, that consistent with our earlier reasoning, returns to the set of activities necessary to enact barriers to further competition are the meaningful measure. And, whether there is emerging a situation wherein it is necessary to intervene to prevent net detriment to social welfare is left to the policy analysts.

Many producer level discussions, for example, are based on the assertion that packers are able to depress price by stifling competition. However, if one considers the returns to the "infrastructure-investment" in the packing industry, the price bids for cattle may seem more appropriate. Consider the resources a set of producers would employ if they were to effectively organize and enforce a fed-cattle cartel. If this could be enacted at a cost that would allow the members to experience a net gain after paying the cartel costs, they essentially could do so. Of course, enforcement and organization is nearly unfathomable, hence it would seem that the above strategy is also unrealistic. More directly, if the producers are being exploited by the packers who are earning an "unfair" return, the shrewd producer would sell his production short and invest the proceeds in the packer or in assets whose returns are highly correlated with those of the packer.

A similar analogy could be this: suppose that you think the prices of cars are too high enabling the producers to earn an unfairly high rate of return because they are stifling competition. If you can collect the necessary resources to produce similar items and still earn an adequate rate of return by marginally underpricing the competition, then you are free to do so. But there is virtually no means of acquiring the control of adequate resources to effect this plan. Therefore, you must conclude that part of the automakers return goes to pay for the investment in their ability to wield such market power -- a return to their investment in competition *for* the market. Again, a more direct strategy to dilute their ability to maintain "unfair" rates of return is to sell short your own product and invest the proceeds in their automobile production, later using the proceeds of their returns to close out your short position while keeping the excess windfall difference. If enough of us do this, we will drive the "unfair" returns down and boost the rate of return to the commodity we are trying to short until the returns again are fairly aligned.

**It is possible that more attention should be paid to meatpackers competition for markets as they seek to protect their investments and less attention be paid to competition in the markets after consolidation has**

occurred. There may be benefits to the producer via competition for the fed cattle or other livestock market.

## Up Can Be Down

A new perspective on the old concern of consolidation and market power in the face of changing product markets relates to the relative length of vertical markets. By that we mean a careful consideration of implications of value-added sectors and further processed uses is needed. While we collectively cheer the successful niche marketer's use of a high value-added end product we warn for a careful analysis of "real" effects. For example, suppose a new product named "McWings" caused the end use value of chicken wings to rise from \$1/lb. to \$4/lb. Suppose further that McWings represents a perfect substitute for the same total value of wings that are currently demanded and no more. If prior to McWings introduction the producer received 10 percent of the end-use value or \$.10/lb. for wings and after the introduction of McWings they get \$.20/lb. or 5 percent of the end-use value, it is difficult to say if they have gained or lost. As more highly processed foods occupy a larger share of the total consumption of meat products, the distance from the consumer, or length of the vertical marketing channel increases, thereby making the producer less able to directly participate in the value addition process.

Economic theory would suggest that the answer lies in the relative contributions of the set of McWing activities and production activities to the value of the end product. Although a producer's position may eventually erode as his "asset" becomes positioned further down the vertical chain, the relevant set of investment opportunities is expanded. The ideal response is to continue the search for the best set of investment activities. If a producer remains competitive relative to other producers and the total demand, the best investment may remain in the set of production activities. However, recognize that just as new technology may make old methods relatively more expensive, new market opportunities may displace traditional markets for products and commodities.

The issue of value-addition also makes the traditional measures of concentration difficult to interpret. For example, consider the most recent annual rankings published by *Meat and Poultry* which suggest that Sara Lee is the number four firm in the meat-processing industry. At first this may seem to be an odd occurrence, since Sara Lee is not typically thought of as a meat processing firm. However, in the context of the value-added processing level of the beef system described earlier in this section, Sara Lee becomes an important force, along with firms like Oscar Mayer, Hormel, and others. Although traditional measures of concentration are

not based on sales figures, the measures which are based on percentage of livestock slaughtered may inaccurately reflect the true concentration in the beef system as large value-added firms increasingly account for a larger percentage of final products sold.

**As we move through the decade of the 1990s, those concerned with concentration levels will need to employ a broader perspective if true measures of concentration within the entire beef system are to be developed. The levels of concentration may be significantly different than originally calculated with traditional measures when these new realities are considered.**

## *Understanding the New Realities*

Much of the above discussion relies on a reconceptualization of the activities in the production-retail chain as investments of capital whose returns depend on the asset's risk-return characteristics and relationships with the other investment opportunities. We submit that the problem statements and inquiries often encountered in the literature may be reduced to that of discussing the formation of an optimal portfolio from the available assets, where the assets are appropriately defined. Much of the literature's exposition on this fact has taken place in the realm of traditional asset (such as stocks and bonds) valuation.

**Once we recognize the similarity between holding a position in a commodity or adding value to a product and making an uncertain investment in an asset, we can bring to bear a new set of theory that conceptually improves the analysis.**

In this section, we reformulate a discussion of the linkages in prices among cash, futures, forward, boxed beef, and other derivative assets and then offer some more traditional empirical evidence of the observed time series price behavior in the various markets.<sup>3</sup>

Note that throughout the discussion the terms price and yield are used interchangeably. Since price relatives uniquely define yields, apparent differences between a price and a yield approach are only a matter of emphasis, not substance (Malkiel). Before proceeding, we need to present a few concepts and define some useful notation.

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<sup>3</sup> For a very thorough and compelling set of analogous arguments for interest rate contracts in the spot, futures, and forward markets, see Kane. Our notation is similar to the notation contained therein as it is fairly simple and no other single set of notation has emerged in the literature.

- **Concept 1:** Risk and uncertainty are assumed to be undesirable. That is, if we consider two random variables representing payoffs or returns streams with the same mean but different variances, rational investors will prefer the returns stream with the smaller variance. This relationship is akin to the *Expected Utility Hypothesis* which says that the expected utility of a gamble is equal to the probability weighted utility of the outcomes which, for typical utility functions, is less than the utility of the probability weighted outcomes. It may be algebraically stated in terms of the relationship between capitalized rates of return and prices as:

$$E_t(P_k) = E_t[1/(1 + R_k)] \neq 1/(1 + E_t(R_k)), \text{ for } k > t$$

where  $t$  is today's date and  $k$  is expiration date of an investment that yields stochastic  $R$  and thus is worth  $P$  per dollar of final value. This formula is a simple restatement of a basic capitalization or discount formula used to compare values over time. A logical consequence of this fact is that if variability or uncertainty about a value is deemed undesirable, then stochastic values (i.e. value to packer of cattle or to retailer of primal cuts) will elicit bids that will be less than the mean value of the stochastic process. *In other words, if there is uncertainty to the packer as to the yield from buying cattle, the bid will be less than the average value of cattle for any given lot.* The size of the divergence between the mean value and the rational bid value is related to the dispersion in possible realized values of the commodity in the future. More variability about this value will lead to a greater risk-penalty discount from mean values.

- **Concept 2:** Efficiency is defined herein as the "law of one price" which asserts that two random variables with the same but unknown payoffs in all future possible states will have the same current price. In other words, *the form of the investment is irrelevant;* what matters is strictly the payoffs in the various states or outcomes. Note that this concept does not imply that risk is unimportant, rather that similar risks are similarly important. Note also the difference of the use of the word efficiency from the traditional Fama sense.
- **Concept 3:** Only non-diversifiable risk is compensated. In an example above, the packer bearing the risk of the "packed" value of cattle is compensated for bearing the risk by bidding less for the live cattle. *If the producer bore this risk by accepting payout based on realized carcass yield, presumably he would realize the mean value for doing so.* If costless hedges in values are available, there is no need to compensate for bearing risk. The consequence of this concept is that *all*

available sets of hedges (diversifications included) must be considered as potential investments to avoid needlessly bearing uncompensated risk.

- **Concept 4:** The economic agent actually bearing the non-diversifiable risk is compensated. It is often quite difficult to define and assign the true consequences of uncertainty about a variable to the proper agent, but only the party truly bearing the risk is compensated.
- **Concept 5:** Temporal price risk takes many forms and has many dimensions. When we refer to price risk, we include at least three possible sources. First, the commodity own rate of return versus the erosion in conversion value to other goods in the economy describes a sort of pure inflation risk and time value risk. Secondly, there is the commodity own rate versus the relative value in the processed or value-added good it is converted to which resembles an internal yield risk. Thirdly, the correlation in the above two sources of time-risk or the uncertainty about the conversion rate from the processed product to other goods in the economy.
- **Concept 6:** The relevant time interval is defined by a particular agent's *investment horizon*, or the length of time an investment (product) maintains its current form. For our purposes, relevant intervals of time may be: a) time in the production channel (feedlot); b) from the time the live cattle are priced to the time of delivery to the packer; c) the packer-processing and shipping stage; d) from the time the retailer contracts a price to the sale of the products. Note that this blurs the time dimension in that a unit of time now relates to a production/processing/pricing lag rather than the passage of calendar time.

Many efforts have been directed at explaining the apparent relationships and divergences in the time series behaviors of the products in different stages from production to retail in the beef sector. We postulate that the redefinition of products as temporal investments and that recognizing the implicit cost of completing markets in the various price and time dimensions causes divergences in the price paths to be expected. That is, different rates of returns to the activities in different strata of the beef continuum are to be expected given the differing characteristics of the different forms of investment. The backbone of our argument is that the divergences among the rates of return from various market strategies over the time intervals may be interpreted as market completion premia, a return to the agent who completes the market. Once we recognize the implicit and explicit costs of guaranteeing future and forward market

performance, divergence among strategy yields becomes the typical equilibrium state (Kane).<sup>4</sup>

The above theory, while fairly general, may still be difficult to test and apply empirically. For example, the packer-retailer interface may involve many products that may best be "hedged" with interest rate contracts rather than with cattle futures if protection of the investment is the need. Nonetheless, it is still appropriate to consider an approach to conceptualizing the investment-style products that are traded in meat wrappers in a somewhat different way.

### *Pricing Impacts: Linkages Revisited*

In what follows, we attempt to give some empirical evidence as to the length of some of the relevant investment intervals and the strength of the linkages among selected level of the vertical chain. The data we use represent prices at various stages of the processing chain. We use data from USDA Market News (the Blue Sheet), the Meat Sheet (the Pink Sheet), and the Chicago Mercantile Exchange Research Department<sup>5</sup> test for and identify the temporal linkages that manifest themselves in the data. As with much of the past literature, we do so in the context of Granger-temporal causality. While there is less than complete agreement as to the proper interpretation of Granger-style studies -- for example Granger tests have been shown to suggest that Christmas cards sales Granger-cause Christmas (Bishop)<sup>6</sup> -- we chose the relatively conservative interpretation that the approach is useful for detecting and confirming temporal relations among observed data. This view has been widely discussed and applied in the agricultural economics literature, including studies of price discovery in cattle and beef markets (e.g., Hudson, Hudson and Purcell, Oellerman and Farris). A more complete description of the models employed and the data series investigated is given in appendix A.

The data cover the period from January 1, 1987 to June 30, 1989 which is considered to be recent enough to illustrate directions of change in the structure of the markets over time by contrasting the results to previous

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<sup>4</sup> For more information on a research effort that pursues this orientation, contact the authors at Cornell University or at the University of Illinois.

<sup>5</sup> The authors would like to express their appreciation to the following people for their assistance in securing data for the analyses reported herein: Mike Erwin of USDA Market News in Des Moines, Iowa, William Albanos (publisher of the Meat Sheet), and Dan Gudmunson of the ME Research Department.

<sup>6</sup> This anecdote on causality tests is given in Kennedy and is attributed to Bishop.

work. The causality flows were tested using daily data in a bivariate vector autoregressive framework (VAR). The procedure involved first selecting the most statistically appropriate lag length to consider for exerting a causal influence between variables. For example, the futures to cash relationship may indicate that beyond five days in the past, there is no improvement in predicting one variable using past values of the other. Then, the significance of the restriction of no causality from one equation to the other was tested. If the null hypothesis of no causality were rejected, then there is evidence of Granger causality from the variable restricted in the test to be zero toward the other series. More details of the model are found in Appendix A and further detail is available from the authors.

It may be most interesting to discuss causality in terms of related price changes. In contrast to previous work, we found that these data were not always well behaved in first differences and that the cash and futures series had different time series representations. Further, we note that some authors have suggested that differencing in a VAR framework is not useful as it "throws away information" (Fuller, Doane). A further statistical caveat should be added here as well. Because we are investigating a set of linkages in time that are the result of influences of a wide array of other unobservable influences, we are forced to consider the degree of reduction in the structural equations that leads to the observed data (Sherrick and Hudson). Much like the observation that Christmas cards may statistically cause Christmas, we need to reconsider the structure suggested first by economic theory and then view the possibly bashful data with an eye for clues it reveals in a time series representation. This point is made clearly in work by Marsh and Brester which indicates that "The reduced form model does not reveal all the sources of rigidities in beef price adjustments...delays can occur because of methods of price discovery such as cash negotiating, forward contracting, or formula pricing".

In the terminology of Granger studies, it was found that the ten-city average cash price and futures prices exhibited high degrees of interaction. Futures were found to cause the average cash price more strongly than the feedback from cash to futures. Thus, although it may appear that new market information is registered in the futures market more quickly than in the cash markets, no pervasive one-way dominance was found. The lag-length selection criteria point to a maximum lag-length of five days (traded days, excluding weekends and holidays), but was only slightly more significant than a two day lag length in the test relating futures to cash prices. Most previous studies (Hudson, Hudson and Purcell, Oellerman and Farris) have found that the two or three day lag length



was sufficient in explaining the linkages. However, many of our models pointed to a five-day lag as capturing the significant correlations in price movements.

As an alternative to the 10-city average price, the linkages were examined using the Amarillo cash price. The results were qualitatively the same, but marginally weaker in significance, with the cash price exerting little influence on futures. This result is as expected in that the markets appear to react to similar pervasive economic information but the effects in a causality sense are weak. The average cash price to boxed beef price relationship is highly significant showing a five to six-day lag in influence from cash to boxed beef. Again, use of the Amarillo cash data weakens the relationship but does not change the direction of causal flow. By transitional arguments, we would therefore expect the futures price to exert a causal influence on boxed beef. Unfortunately, the two lag length selection criteria were not in agreement as to the proper lag length for the boxed beef models, so a "search" was performed over the first 10 lags. The test statistic may therefore be biased toward rejecting the null of no causality, but the cautious results indicate marginal causality (at the 10% level) at lag lengths of two, three, five and six days. Finally, the various boxed beef series and primal cutout series were tested for temporal influences. As expected, there is a high degree of feedback and agreement in the direction of price moves in these various markets. In particular, the boxed beef #3 series from USDA has a two or three-day lagged influence on the primal and subprimal cutouts as reported in the Meat Sheet. This may reflect the manner in which the data were collected or reported as much of the data relies on daily surveys and the responses may be tabulated differently. Further descriptions of the data are also given in Appendix A.

A final comment about the temporal relations tests is in order. Use of daily data entails many statistical problems. First, weekends and non-trade days make the observation intervals inconsistent and true time series models are therefore inappropriate. Also, the cash markets are early week markets and the Thursday and Friday prices may have a different set of information imbedded than the early week prices. Finally, inability to remove the correlation in observations that occur on the same day of the week biases the statistics possibly toward rejection. Notwithstanding, the evidence still points to a complex set of linkages that are most quickly registered in investment activities with the shortest durations. And further, the direction of causal flows agrees more strongly with the processing linkages than the reverse.

The net result is that complete and complex inter-stage and temporal linkages exist in the beef system. These results support the earlier contentions that no one phase, such as production, should be treated in isolation. During the 1990s, it is likely that the inter-stage linkages will be tighter still and the entire system will start to react to economic stimuli such as changes in consumer buying patterns without the time delays we have seen historically.

## *Implications for Producers*

The future of the beef production and marketing system depends on a continued dialogue between well informed participants. *That dialogue must include players from all levels of the system and will require each level to accept and understand that the changes which occur at any one level will by definition impact the other levels of the system.* We have argued that production is endogenous in the beef system and suggested that new linkages will be formed using information technology to improve overall efficiency in meeting consumer demands. Further, the business performance paradigm has been used to demonstrate a new perspective for beef production and marketing in an increasingly competitive world. These perspectives and other issues which have been presented suggest the following implications for producers, both feeder-stocker producers and cattle feeders, as we move into the decade of the 1990s.

- **Demand for consistent quality and predictable supply flows will increase.** Packers are likely to expand their reliance on captive supplies in an effort to better address the needs of the value-added processor and the food service industry. *Relationships between feedlots and packers which provide for a scheduled flow of the right quality of animals for the particular packer are likely to expand, with premiums being paid to the feedlots in a "sharing of the gains" from coordination.* The implications of this practice for pricing are unclear at present. An increased reliance on pricing to reflect the value of the final product is expected and each packer will likely evolve their own pricing system reflecting the types of products which they market.<sup>7</sup>

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<sup>7</sup> The notion that each packer requires a different type of animal and that the ultimate value of the animal is different from packer to packer, based on their approach to trimming out the carcass, is troubling to some. The concerns mirror those expressed about grade and yield programs when they were first gaining popularity for hogs. Given the perspective presented above, it should be clear that this is simply one aspect of competition in the industry. To attempt to enforce a common standard in an industry where the consumers are clearly divided into a number of segments would not be appropriate. Because of this, we can expect to see different

- **New buyers will enter the market.** As the value-added segment of the industry expands and product development efforts increase, *new buyers are likely to enter the market.* This will impact producers in two ways. First, the traditional buyers will face increased competition for captive supplies from these buyers which may impact prices in some local areas. Second, the demands for specific types and quality animals will limit access to these new buyers. Since these buyers are interested in marketing to specific niches, they will seek certain attributes in the animals they purchase and they will only need a few animals. This new demand can be satisfied, therefore, by a few feedlots and the impacts will be primarily local.
- **Adversarial posturing will diminish.** As the players at all levels of the beef system -- particularly the production and packing levels -- realize the opportunities which coordination can bring, the adversarial posturing between different levels of the system will diminish. *If this does not happen, then the entire beef production and marketing system is likely to continue to suffer.* The current dialogue seems to indicate that this posturing has diminished somewhat in the past few years (months?), but more information will need to be shared in order for the industry to survive. At the same time, it must be recognized that there are different goals and objectives at each level of the system and that in many ways business is business -- which will limit total information sharing between levels. Regardless of the ultimate outcome, those in the sector who bear the risk will need to realize sufficient returns to keep their investment in the industry. If those returns disappear, so will they. It is because of this need that the adversarial posturing will diminish.
- **Consolidation will level off and become more difficult to measure.** Regulatory attention is likely to limit further consolidation of the beef packing industry. In addition, the potential for small firms to develop niche markets for high value products actually may decrease consolidation in some market areas. *The impact of concentration within the sector, particularly at the producer level, will become increasingly difficult to measure as the value-added segment of the market expands.* Indeed that bimodal focus -- with a few large firms focusing on slaughter and a number of smaller operations focused on further processing -- is likely to mask the true levels of concentration within the system. If consolidation of these smaller firms into larger food firms continues, the ultimate levels of concentration near the consumer may approach or exceed those near the producer level of the system.

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pricing systems evolve and no doubt there will initially be some confusion until the coordination within the system works itself out as discussed above.

- **Pricing systems will change to reflect value.** The need for value-based pricing systems has been discussed widely. As the industry evolves in the next decade, *new pricing systems will emerge to reflect the value of the animal in its final use.* It is, however, quite likely that this move to value-based pricing will result in a number of mixed and potentially confusing signals to producers during the developmental stages. In particular, for such a pricing system to be effective, additional information must be incorporated. A single price to reflect the average animal will essentially become meaningless. The process will be helped by information technology as noted above and should result in a more efficient system in the long term, although the short run may yield mixed results. Movements toward evaluating the linkages in terms of their investment characteristics will help improve this change.

## *Concluding Remarks*

A number of perspectives and arguments have been offered in this chapter regarding the changes which have occurred and continue to occur in the beef production and marketing sector. At times the tone has been a bit harsh as we attempt to dispel a few of the long held misconceptions. In other places we may seem to be preaching about the way things should be in an ideal world, which simply doesn't fit the beef sector. The view that the sector is actually an interconnected system is the common theme, a theme which illustrates why consumer demand drives the sector, why the business performance paradigm is increasingly important within the sector, and why pricing systems are changing to reflect the value of the final product. As noted above, this view of the beef production marketing system is not new. It spans academic and industry discussions over the past quarter century. Despite this, we seem to have made little progress in understanding the operations of the system. As history begins to recycle, perhaps the problems can be better addressed in the future by redirecting research attention to encompass:

- **Inter- and Intra-disciplinary research efforts.** Much of the discussion presented here draws on concepts which are more often addressed in finance than marketing. *There is a pressing need to bring an intradisciplinary perspective to bear on problems related to the beef system.* Such approaches can shed new light on old problems and offer an increased understanding of what is occurring within the sector. In addition, the business approach relied on within the system suggests the need for interdisciplinary efforts with business researchers.

- **Adopt an anticipatory versus a reactionary focus.** Too much of the research being done related to the beef sector is reactionary in nature, attempting to address concerns already impacting the players in the system. Additional attention needs to be given to looking to the future and conducting "what-if" analyses of different paths which the industry might take. These what-if analyses need to be followed by "so-what" analyses, to identify the impacts of the changes should they occur. *The focus needs to move beyond describing what is happening or what might happen to what it will mean, and whether the gains in the long term exceed the short-term costs.* Techniques from the environmental scanning and business strategy literature provide a basis for such efforts in the context of the system described herein.
- **Examine the behavioral aspects of the system.** The major limitation in the currently available research is a lack of attention to the behavioral dimensions of the system and the players within it. For some reason, agricultural economists seem reticent to address these issues. For evidence (perhaps causal?) we refer to a discussion from the 1988 conference of the Research Institute on Livestock Pricing (see Conference Proceedings). In discussing the paper by Hudson which called for increased attention to the behavioral dimensions of the market, Rhodes notes that it is not surprising that the behavioral dimensions have not been addressed as "its a lot easier to publish a Fama study then [sic] a psychological study" (p. 113). The time has come to push the publishability issue aside in favor of addressing the pressing questions which impact the industry. *Efforts must be undertaken to increase our understanding of the behavioral aspects of the sector and to incorporate these aspects into modeling efforts.* This issue becomes increasingly important as policy efforts to limit further consolidation are considered.
- **Increase reliance on case studies as a research vehicle.** Case studies can provide an excellent vehicle for addressing some of the issues raised in the preceding point. The use of case studies as a research tool inevitably raises concerns about the ability to generalize from one case study to the world at large. However, as we have noted above, there is a limited amount of information available about the industry. *Case studies could help to alleviate this information void*, while also providing a basis for more complex modeling efforts related to the issues below.
- **Experimental approaches and simulation modeling merit attention.** Unfortunately "the economy is a miserable experimental design."<sup>8</sup>

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<sup>8</sup> This quote comes from the article by Bessler and Brandt where it appears in a discussion of an article by Pierce related to causal relationships (see Bessler and Brandt, p. 143).

Therefore, if we are really going to understand the beef system, and make appropriate recommendations to enhance its performance, some experimentation is needed. *The evolution of computers and other technologies make such experiments possible* and, drawing on information from case studies and behavioral analysis, models of the system can be constructed and tested under various regimes and assumptions. Also, more complex modeling efforts of the system which account for different scenarios in the future should be undertaken to examine the impacts of changes which are likely in the future.

The list could go on, but the point has been made -- there are aspects of the beef system which beg further research attention. The approaches suggested above could yield new insights into the problems within the sector and should yield valuable input into policy discussions. In addition, the understanding gained through such efforts would provide a solid basis for eliminating biases and innuendo from discussions of the industry, while also helping to remove adversarial postures which currently exist.

**In a changed and consolidated industry, the importance of the linkages between the packing-retailing subsector and the producer is likely to be magnified. It will be important that the producer understand that the traditional "middlemen" will place increasing demands on the production subsector to provide the specific quantities and qualities needed to meet the demands of value-added processing. Non-price means of coordination (contracting, integration, etc.) could become even more important in the 1990s. As those adjustments are working themselves out, it will be important that every industry participant avoid adversarial postures and that our research efforts do a better job of sorting out the costs and gains to various participants.**

## *Appendix A: Data and Methods*

### **Data Series Used in Analysis**

Name	Description	Source*
alnearb	Nearby Futures price	A
bjsnearb	Nearby futures corrected for expirations	M
boxb1	Choice 2-3, 550-700#	U
boxb2	Choice 2-3, 700-850#	U
boxb3	Good 2-3, all weights	U
ave10	Ten city average cash price	A
subpr	Sub primal cutout series	A
amtex	Average of the High and Low Amarillo price	U
prime1	Primal 1 cutout value	A
lccdate	Trade day index	
futdif	Futures differences corrected for contract changes	M

M-Chicago Mercantile Exchange Yearbook and/or Research Department

A-Meat Sheet (aka, Pink Sheet)

U-USDA Market News (aka, Blue Sheet)

NOTE: Each series contains 631 matched observations covering the period from 1/5/87 to 6/30/89.

### **Selection of Lag Lengths**

For purposes of comparison of two series,  $y_1$  and  $y_2$  formulated as a bivariate VAR, we need to first select the order of the VAR. The order  $p$  refers to the number of lags included as regressors in the system depicted below:

$$y_{1t} = a_1 + \sum_{i=1}^p \beta_{1,i} y_{1,t-i} + \sum_{j=1}^p \beta_{2,j} y_{2,t-j}$$

$$y_{2t} = a_2 + \sum_{i=1}^p \beta_{3,i} y_{1,t-i} + \sum_{j=1}^p \beta_{4,j} y_{2,t-j}$$

The lag-length  $p$  was selected using the Akaike Information Criteria (AIC) and the Schwartz Information Criteria (SC) as indicated in Judge, et al. The Gauss programming language was used on an IBM compatible 386DTK computer.

For a VAR( $n$ ) the lag selection criteria are defined as:

$$AIC(n) = \ln \det (\Sigma_n) + (2M^2n/T) \text{ and}$$

$$SC(n) = \ln \det (\Sigma_n) + ((M^2n * \ln T)/T)$$

where  $T$  is the sample size, and  $\Sigma$  is an estimate for the residual covariance matrix for a VAR( $n$ ) model. The order of lag is chosen as that which minimizes AIC and SC. If the two approaches did not suggest the same lag length, the  $p$ -value of the final test statistic was examined for each model to check for agreement. The test statistic for the null of no causality was formed as the standard F-test of the ratio of the change in SSE from the restricted to unrestricted models to the estimate of the variance of the first equation in the VAR system allowing for possible causality. A Gauss template of the program is available from the authors upon request. A complete set of results for the possible two way causalities among the series listed above is contained in Sherrick and Hudson.



*Referenced Series:*

Direction of Causality Flow	Maximum lag considered	p-value
Ave10-- > futures	5	.058
Futures-- > ave10	5	< .001
Amtex-- > futures	5	.117
Futures-- > amtex	5	< .001
Ave10-- > boxb3	6	< .001
Boxb3-- > ave10	6	.244
Amtex-- > boxb3	2-10	.021
Boxb3-- > amtex	2-10	.232
Boxb3-- > prime1	2-3	< .001
Boxb3-- > subpr	2-3	< .001

a-- > b implies that series a causes series b.

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# CHAPTER 4: ANNOTATED BIBLIOGRAPHY

John B. Rowsell<sup>1</sup>

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## Introduction

This chapter presents reviews of recent research in the area of livestock pricing. The bibliography is structured under the following general headings; Livestock Price Forecasting, Demand Analysis, Livestock Price Discovery, Efficiency of Livestock Futures Markets, Basis and Basis Risk, Futures Markets Research Reviews and Structure/Concentration. Literature included in this bibliography dates primarily from the latter half of the 1970's through 1989. The citations in the section "Futures Market Research Review" provide historical reviews going back into the 1950s and 1960s. Material comes from a broad range of international, national, and regional journals, as well as conference proceedings, research bulletins, and presented papers. Each annotation is intended to provide a brief summary of the article or paper. Any errors in reporting on the work reviewed is the responsibility of the bibliographer.

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## **Livestock Price Forecasting**

**Kaylen, Michael S.** "Vector Autoregression Forecasting Models: Recent Developments Applied to the U.S. Hog Market." *American Journal of Agricultural Economics*, Vol. 70, No. 3. August 1988. pp. 701-712.

In this paper, a new technique for building Vector Autoregressive (VAR) forecasting models is developed and applied to the U.S. hog market. VAR forecasting models tend to be afflicted with a great deal of variability associated with over parameterization. The author provides a thorough discussion of the strengths and weaknesses of the two main approaches to dealing with over-parameterization - the Exclusion-of-Variables approach and the Bayesian Estimation approach. Based on this discussion, the author develops an alternative approach that uses the data to specify the ordering of the series for potential entry into an equation but allows the researcher to use prior knowledge to partially or totally specify the ordering. This approach is known as IDLAGS (Identity Lags). Using data from the second quarter of 1961 through the fourth quarter of 1976, six alternative models are estimated for the U.S. hog market. The six alternative models were an unrestricted VAR, A Tiao-Box VAR, two Bayesian VAR models, and two IDLAGS. Out-of-sample forecasts were generated for the first quarter of 1977 through the fourth quarter of 1984. The performance of the forecasting models was evaluated using absolute errors and root, mean-square errors. Based on these criteria, the IDLAGS model with prior knowledge provided the best forecasts.

**Schroeder, Ted, James Mintert, Frank Brazle, and Orlen Grunewald.** "Factors Affecting Feeder Cattle Price Differentials." *Western Journal of Agricultural Economics*, Vol. 13, No. 1. July 1988. pp. 71-81.

This paper reports on a study examining the impact of physical characteristics on feeder cattle auction prices. Data on prices and physical traits of feeder cattle was collected from seven weekly Kansas feeder cattle auction markets during the fall of 1986 and the spring of 1987. Data on cattle weighing 300 to 899 pounds for 17,121 lots of 138,027 head were analyzed. The authors stratified the data by sex and weight into four categories to yield a relatively more homogeneous set of prices and physical characteristics for analysis. The stratifying of the data implied that buyers would be bidding on certain types of cattle and the impact on price of specific physical characteristics will as a result be more discernible. In addition, the models estimated in this research explicitly incorporate market expectations by including feeder cattle futures prices as an explanatory variable. The variables that were found to be important in ex-

plaining feeder cattle prices were: weight, lot size, health, muscling, frame size, condition, fill, breed, presence of horns, and time of sale. Fall buyers tended to bid up the price on heavier and bulkier animals and discount lighter on their cattle while spring buyers tended to do the opposite.

**Aradhyula, Satheesh V., and Matthew T. Holt.** *GARCH Time Series Models: An Application to Retail Livestock Prices.* Working Paper 88-WP29, Center for Agricultural and Rural Development, Iowa State University. June 1988. 19 pages.

This paper reports on the estimation of Generalized Autoregressive Conditional Heteroschedasticity (GARCH) models for the retail price of beef, pork, and chicken. The GARCH method allows lagged values of the conditional variance to enter the estimation process. This implies that conditional variances can change over time. Therefore, an adaptive learning process is allowed. The authors provide a thorough discussion of the assumptions underlying the GARCH process, and key factors for consideration in using this technique. Retail prices for beef, pork, and chicken are modeled using this approach. Given the relative stability of meat prices in the 1960s and early 1970s and then the volatile prices of the late 1970s and 1980s in conjunction with evidence of structural change in demand for meat, it is reasonable to expect that the forecast variances associated with these prices would not be constant. The authors estimated GARCH and autoregressive models using quarterly USDA data from the first quarter of 1967 through the fourth quarter of 1986. The GARCH process does not necessarily improve forecast performance, but it does provide more information concerning the precision of forecasts. Analysis of confidence intervals highlights the improvement in precision of forecasts. Conclusions from this analysis indicate that retail meat prices were non-stationary during the 20-year period analyzed.

**Prescott, David M. and Thanasis Stengos.** "Bootstrapping Confidence Intervals: An Application to Forecasting the Supply of Pork." *American Journal of Agricultural Economics*. Vol. 69, No. 2. May 1987. pp. 266-273.

The authors apply a nonparametric statistical procedure known as "bootstrapping" to the problem of building confidence intervals for point price forecasts of pork supply. The thrust of this article is a description of why and how bootstrapping confidence intervals on single equation forecasting equations can be performed. An appendix details the bootstrapping approach to construction of confidence intervals.



Bootstrapping is a computer-intensive method of generating probability distributions when the precise small sample distribution of forecasts are unknown. In this case, the approach taken is to generate a simple OLS model in the form of  $y = Xb + e$  and then randomly select with replacement  $n$  residuals from the vector  $e$  and place the drawing in the  $n \times 1$  vector  $e^*$ , then estimate the dependent variable with the OLS estimated coefficient and the artificial residual. The additional data are then used to re-estimate the OLS coefficient. These re-estimated OLS coefficients are used to construct the joint probability distribution of the OLS estimates. Bootstrapping draws random samples from the available sample with replacement to estimate population variance. In the example reported here, the resampling procedure was conducted 1,000 times. The major limitations to this procedure are cost of computer time and lack of software.

**Conway, Roger K., Charles B. Halahan, Richard A. Stillman, Paul T. Prentice. "Forecasting Livestock Prices: Fixed and Stochastic Coefficients Estimation." USDA-ERS Technical Bulletin. No. 1725. May 1987.**

This report examines alternative forecasting methods for quarterly retail price of beef, pork and chicken. Because of the over predicting of livestock prices in the 1980's by econometric models, the authors contend there is a need for models that offer greater flexibility. For beef and chicken, stochastic coefficient models were superior to the standard fixed coefficient econometric models. The Cochran-Orcutt and maximum-likelihood procedure enhanced the forecasting of pork prices. This report indicates that a constant relationship between explanatory variables and endogenous variables in livestock demand is not correct. The authors suggest that the own-quantity coefficients for meats are relatively stable which suggest fairly stable consumer preference for meats. In addition, they suggest that the real expenditure coefficients of beef and pork alter their value in line with the business cycle. The macroeconomic conditions, the authors suggest, may have a profound effect on determining red meat prices.

**Naik, Gopul and Raymond M. Leuthold.** "A Note on Qualifications Forecast Evaluation." *American Journal of Agricultural Economics*. Vol. 68, No. 3. August 1986. pp. 721-726.

The authors demonstrate the limitation to using the turning point method of qualitative evaluation for forecasting models. Naik and Leuthold define turning point (TP) as existing if  $P(t) > P(t-1) < P(t-2)$  or  $P(t) < P(t-1) > P(t-2)$ , and define no turning point (NTP) as existing where neither of the above conditions are observed. Standard turning point qualitative performance evaluations have employed a 2 x 2 contingency table which compares natural and forecasted turning points and no turning points. The qualitative accuracy of forecasts is measured by comparing the number of consistent actual and forecasted turning points and no turning points with the total numbers of forecasts. The authors point out that this method fails to account for peak and trough NTP's and upward or downward NTP's. The failure to consider these differences could result in misleading interpretation of forecasts. Naik and Leuthold suggest an alternative is to develop a 4 x 4 contingency table that distinguishes no peak TP from trough TP and upward NTP from downward NTP. They define the categories as follows: peak turning points (PTP)  $P(t) < P(t-1) > P(t-2)$ , upper and no turning point (UNTP)  $P(t) > P(t-1) > P(t-2)$ , and downward no turning point is  $P(t) < P(t-1) < P(t-2)$ . Qualitative accuracy is measured by comparing the number of forecasts that were indicating correct directional movement with the total number of forecasts. The authors contend that this form of analysis provides more information about the accuracy of forecasts.

**Stillman, Richard P.** "A Quarterly Model of the Livestock Industry." USDA-ERS. Technical Bulletin Number 1711. December 1985.

This report describes in detail econometric models of the cattle, hog and broiler industries. The objective of the model building effort was to provide a tool to situation and outlook analysts and to emphasize identification of a structured model to aid outlook analysts in making decisions. The model is useful in analyzing "what if" scenarios. Ordinary least squares (OLS) was used to estimate models over the period 1970-81. The model were validated for 1970 through 1981 and then tested via an out-of-sample test for 1982, 1983 and 1984. Validation criteria used were turning point errors, mean absolute percentage error and Theil's inequality (U2) coefficient. Models proved to have some reliability problems in the out-of-sample time periods. The author attributed the problems to government programs and drought. This bulletin provides a comprehensive

detailing of biological and economic factors to consider in modeling the livestock industry.

**Rucker, Randall R., Oscar R. Burt, Jeffrey T. LaFrance.** "An Econometric Model of Cattle Inventories." *American Journal of Agricultural Economics*. Vol. 66, No. 2. May 1984. pp. 132-144.

The article attempts to overcome weaknesses in previous research which has modeled the complex dynamics of cattle inventories in the post World War II period. In order to avoid problems associated with using the same data to select an appropriate model and estimate parameters, a preliminary analysis was conducted in Montana. The authors did not impose a priori restrictions on the lag structure. They attempted to include variables that have indirect effects based on the rational expectations hypothesis. Stochastic and nonstochastic components were partitioned to permit clearer interpretation of the dynamic structure. The authors identified a cyclical path in cattle inventories of about eleven years. This cyclical behavior is the result of a cyclical path in cattle prices that pictures a supply response that has both economic and biological constraints. The authors note that in modeling cattle inventories, researchers need to be cognizant of regional shifts in cattle production that suggest it may be more appropriate to develop regional rather than national models.

**Bessler, David A.** "An Analysis of Dynamic Economic Relationships: An Application to the U.S. Hog Market." *Canadian Journal of Agricultural Economics*. Vol. 32, No. 1. March 1984. pp. 109-124.

Bessler uses vector autoregression to identify economic relationships in the U.S. hog market. The vector autoregressive technique estimates reduced-form relationships across every variable in a multi-variable system. This approach offers flexibility in that most economic relations are dynamic. The variables and lag lengths used ought to be more practical with vector autoregressive analysis than with static econometric analysis. A system of U.S. hog prices, sow-farrowings, hog slaughter, corn prices, and disposable income, for quarterly data from 1958 through 1981, was analyzed. Sow farrowings were affected to the largest extent by hog prices at lags of six quarters or less. The effect of corn prices on sow farrowings lasted eight to 10 quarters. As would be expected, hog slaughter is affected by sow farrowings at lags of four quarters and less.

Dunlap, Lawrence E., John R. Franzmann. "Estimating the Quarterly Number of Cattle on Feed." *Oklahoma Current Farm Economics*. Vol. 56, No. 3. September 1983. pp. 3-7.

Dunlap and Franzmann develop a very simple model to forecast the 13-state quarterly cattle-on-feed inventory. The model specifies the 13-state cattle-on-feed inventory as a function of the number of cattle-on-feed in seven states the month prior to the quarterly report and the quarters of the year. The model explained over 93 percent of the variations in cattle-on-feed at the 13-state level for the period estimated 1972 to 1979. In 14 quarters outside of the sample period, this model's largest error was 4.7 percent and smallest error was .1 percent.

Hobbs, J. L. and Cary W. Herndon. "Hog-Corn Price Ratio vs. Separate Hog and Feed Prices in Estimating Pork Production." *Oklahoma Current Farm Economics*. Vol 56, No.3. September 1983. pp. 7-13.

This study updates Meikle's study (American Journal of Agricultural Economics, February 1977.) The authors added quarterly data from 1976 through 1982. Using the same polynomial distributed lag models as Meikle developed, the authors estimate the two models over the 1970-82 time period and over the two shorter periods of 1970-75 and 1976-82. The time period 1970 through 1975 was a period of highly volatile prices. For 1970-75, the hog-corn ratio equation produced a coefficient of determination of .551 compared to .991 for the hog-feed equation. During the 1976-82, period the hog-corn ratio equation produced a coefficient of determination of .931 compared with .957 for the hog-feed equation. For the 1970-82 period, the hog-corn ratio equation had a coefficient of determination of .498 and a marginal F-statistic while the hog-feed equation had a coefficient of .908 and a very significant F-statistic. These results tend to confirm Meikle.

Marsh, John M. "A Rational Distributed Lag Model of Quarterly Cash Prices." *American Journal of Agricultural Economics*. Vol 65, No. 3. August 1983. pp. 534-547.

A rational distributed lag model of quarterly fed cattle and feeder cattle prices is presented in this article. Systematic components of the lag structure are estimated using nonstochastic difference equations. The approach minimizes problems from lack of proper error structure identification. The rational lag models are compared to autoregressive moving average error processes and static specifications with serially cor-

related disturbances. The author contends that adjustment of quarterly cattle prices to changes in exogenous variables is not instantaneous, suggesting the market is constrained by psychological, economic and technical factors. The results of Marsh's analysis indicate that a \$1.00/cwt. increase in the price of slaughter cattle will raise contemporaneous feeder cattle price by \$.85/cwt. The long-run effect (the period of time in which a change in the exogenous variable was completely felt in the dependent variable) was \$1.50/cwt. An increase of \$1.00/bu. in the corn price reduced contemporaneous feeder prices by \$1.00/cwt., but over the long-run the reduction in feeder cattle prices was \$7.87/cwt. The effect of a change in placements on feeder cattle prices peaked out in two quarters and stabilized in ten quarters. The impact of a change in fed cattle prices peaked out in one quarter and stabilized in four quarters.

**Dixon, Bruce L. and Larry J. Martin. "Forecasting U.S. Pork Production Using a Random Coefficient Model." *American Journal of Agricultural Economics*. Vol. 64, No. 3. August 1982. pp. 530-538.**

To address problems econometric forecasting models have had in making accurate intermediate-term forecasts of pork supply and hog prices, the authors employ a stochastically and systematically time-varying parameter specification. The framework used in this analysis is a quarterly recursive equation of U.S. hog supply vs. a function of hog and feed prices and quarterly intercept shifters. A randomly and systematically varying coefficient model (RSVC) as well as an ordinary least squares (OLS) model, were used. The RSVC model was employed because economic relationships are not static over time, and the use of intercepts and slope shifters is not adequate in modeling gradual changes. The authors sought to test three specific hypothesis concerning changing economic relationships in hog production. The first is that there has been a systematic decline in production responses to hog prices over time due to the move to capital intensive confined production units, resulting in a smaller amplitude to production cycles. The second hypothesis tested is that because of confined production and increased specialization, seasonal variation in production has declined. Finally they examined an hypothesis that when grain prices rise, producers market their grain directly rather than indirectly as hogs. The authors concluded that their empirical evidence rejects the hypothesis that hog production has become less responsive to price. They found no random or systematic variation in the coefficient for hog prices. Their results do suggest that there has been a decline in season variation of hog production. The analysis carried out showed some inverse responsiveness to grain prices when grain prices rose, but feed prices appeared to be an insignificant explanatory variable. The RSVC model

provides more accurate forecasts for the short and intermediate periods than the OLS model.

**Menkhaus D. J. and R. M. Adams. "Forecasting Price Movements: An Application of Discriminant Analysis." *Western Journal of Agricultural Economics*. Vol. 6, No. 2. December 1981. pp. 229-238.**

This article demonstrates the usefulness of modifying economic forecasting models of price to include a forecast of direction of price movement. The models developed forecast the price change between fall feeder calf prices and spring yearling prices. The implicit contention is that price change is made up of two components: direction and magnitude. Forecasts of prices can be enhanced if the direction of the price movement has also been forecasted. Discriminant analysis is carried out for the period 1925 through 1969, and the period 1970 through 1980 was used as an out-of-sample test of the forecasting ability of the model. In forecasting the direction of price movement, the authors concluded that the discriminant model performed slightly better than the regression framework. If the correct directional variable is used, forecasts of price magnitude are improved. However, if incorrect forecasts of direction are used, the forecast of price change was worse than if no directional variable were included.

**Plain, Ronald L. "Predicting Market Hog Price." *Oklahoma Current Farm Economics*. Vol. 53., No. 4. December 1980. pp. 13-17.**

This article compares four simple methods used to predict hog prices 16 weeks ahead and 46 weeks ahead. The 16-week period reflects the time required to finish a 50 lb. pig. The 46-week period reflects the time required to breed a sow and finish the pigs at 230 lbs. The author compared a naive regression equation which says future hog prices are dependent on current hog prices with regression models and with future price dependent on the current futures market quote for delivery in 16 weeks or 46 weeks. The other two methods compared were a harmonic regression model that identifies cyclical trends and an economic regression model that relates price to supply factors. Results indicate that the futures market provides superior predictive ability over the naive model. The harmonic regression predicted the best and suggested a 2.75-year short cycle and a 9-year long cycle for hog prices.

Helmer, Glenn A. and Larry J. Held. "Comparison of Livestock Price Forecasting Using Simple Techniques, Forward Pricing and Outlook." *Western Journal of Agricultural Economics*. Vol. 1, No. 1. June 1977. pp. 157-160.

This study examined and compared the estimation variability of eight methods of forming price expectations for fed cattle and slaughter hogs. Hypothetical feeding situations for eighteen continuous four-month feeding programs between June 1969 and February 1975 were examined. The models examined were:

1. The expected livestock price for feeding period is equal to the corresponding weekly price from the previous year.
2. Forecasted price for the end of the feeding period is the price at the beginning of the feeding period.
3. The expected prices were randomly selected from the previous 52 average weekly quotations.
4. Expected price was a one-year average of previous prices.
5. The expected price was based on an eight-month linear trend of prices extrapolated four months into the future.
6. Expected price was the futures quote for the relevant month at the beginning of the feeding program.
7. The price expectation was drawn from the *Successful Farming* outlook.
8. Expected price was drawn from the USDA *Livestock and Meat Situation* outlook.

The price expectations were evaluated based on a measure of bias and the variability of the estimate. For cattle, the USDA outlook provided the least bias and lowest variability, the *Successful Farming* outlook provided the greatest bias and the highest variability. The analysis for hogs indicated the USDA had the lowest variability but was fifth in bias, whereas a simple linear trend provided the least bias in expectation and the second lowest variability.

Meilke, Karl D. "Another Look at the Hogs-Corn Ratio." *American Journal of Agricultural Economics*. Vol. 59, No. 1. February 1977. pp. 216-219.

In this note, Meilke updates the work done a decade earlier that suggested the hog-corn ratio was a deficient proxy for profitability in the pork sector. Meilke's objective was twofold. First, to determine the supply response of US pork producers to changing hog and feed prices over time, and second to determine if the hog-corn ratio is an adequate predictor of

hog supplies when the prices of hogs and feed are volatile. Polynomial distributed lag models for two time periods, 1960-69 and 1970-75 were used. Two equations were estimated for commercial pork production. In one, the hog-corn ratio and seasonal dummies were explanatory variables. In the second equation, the price of hogs and feed prices along with seasonal dummies were the explanatory variables. For the 1960-69 period, both functions explained over 90 percent of the variation in hog supply. For the 1970-75 time period, the hog-corn price ratio equations dropped to explaining 67 percent of the variations in hog supply while the hog and feed price equation explained 98 percent. Meilke notes that over the time periods examined, the response of hog supply to change in hog and feed prices has become more rapid. The elasticity of supply response with respect to both hog and feed prices are three times as large in 1970-75 as in the 1960-69 period.

**Foote, Richard J., Sujit K. Roy, George Sadler.** "Quarterly Predictions Models for Live Hogs Prices. *Southern Journal of Agricultural Economics*. Vol. 8, No. 1. July 1976. pp. 123-126.

The authors set out to develop a quarterly prediction model for live hog prices based on the structural relations that are the price determining forces in the sector. Quarterly simultaneous equations models for predicting live hog prices consisted of a stochastic price consumption relation for pork, a stochastic relation between live hog prices and retail pork prices, a stochastic cold storage stock of pork products valuation, and a market-clearing identity for pork product. The models were estimated separately for each quarter with 15 years of data beginning in 1957, with 1972 through 1974 reserved for an out-of-sample test. It was concluded from this work that the predictive accuracy of structural models improves when a subset of all exogenous variables are used based on the consistency of coefficient signs.

**Foote, Richard J., John A. Craven, Robert R. Williams.** "Quarterly Models to Predict Cash Prices of Pork Bellies." *American Journal of Agricultural Economics*. Vol. 54, Number 4. November 1972. pp. 603-610.

This article develops quarterly three-equation models designed to predict wholesale cash prices for fresh pork bellies at Chicago. The models were fitted to quarterly data for April-June 1957 through January-March 1971. Separate equations were estimated for each quarter. The authors felt it would be inappropriate to use dummy (or 0-1) variables to distinguish between quarters. The models fitted were a price consumption relation-



ship, a demand for storage relationship, and a supply-demand identify. The demand for storage is unique in this study. The authors suggest that it is the major contribution of the models in terms of methodology and a major factor in the success of the equations in predicting prices. Storage stocks are presumed to be held because of expectations of storage profits. Estimation problems resulted in the April-June model being estimated with total data while the three remaining quarterly models were estimated with per capita data.

## Demand Analysis

**Purcell, Wayne D. "Demand for Red Meats: Basics, Importance, Needs," Demand Strategies Conference, National Livestock and Meat Board, Charleston, SC. August 27-28, 1989. 27 pages.**

This paper was prepared for a lay audience and was designed to stress basics of demand for meats. Emphasis was placed on the distinction between a change in quantity consumed (per capita consumption) and a change or shift in the entire demand schedule. Purcell documents what happened to the demand for beef and pork between 1977 and 1988, and demonstrates how the observed decreases in demand prompted industry contraction, especially in beef. He shows that the inflation-adjusted price for beef had to drop over 30 percent between 1979 and 1986 to entice the consumer to accept essentially a constant per capita supply. Citing this development as a "textbook" case of declining demand, Purcell suggests strategies that the industry needs to pursue to reverse the negative trends. Increased activity in product development to match the needs of a changing consumer was cited as a necessary condition to improve the demand situation.

**Purcell, Wayne D. *Analysis of Demand for Beef, Pork, Lamb, and Broilers: Implications for the Future*, Research Institute on Livestock Pricing, Research Bulletin 1-89, Agricultural Economics, Virginia Tech, Blacksburg, VA. July 1989. 50 pages.**

The demand for beef, pork, lamb, and broilers is analyzed across the 1960-1987 time period. Quarterly data are employed, and the four quarters of 1988 are employed as an out-of-sample test of the models. Purcell indicates that the traditional economic demand shifters such as prices of competing products and consumer incomes are inadequate to explain the developments in beef, pork, and lamb during the 1977-87 time period. Single equation price and quantity dependent models were analyzed, and time-related patterns in the model residuals indicate preference-related shifts in demand. Yearly shift dummies were included, and were found to be statistically significant and increasingly negative for beef from 1977 through 1987 and for pork from 1977 through 1986. Out-of-sample tests suggested the demand for pork, which increased in 1987 for the first time in the 1980s, continued to increase in 1988. The same tests for beef suggested the demand for beef was starting to stabilize, but had not increased. During the 1980s, the same type of analysis suggested the demand for ready-to-cook broilers recorded several year-to-year increases

as increased per capita supplies were moved into consumption at higher inflation-adjusted prices.

**Moschini, Graucurlo and Karl D. Meilke.** "Modeling the Pattern of Structural Change in U.S. Meat Demand." *American Journal of Agricultural Economics*, Vol. 71, No. 2. May 1989. pp. 253-361.

This paper examines the evidence of the existence and nature of structural change in meat demand. The authors have assumed weak separability in order to examine only beef and veal, pork, chicken, and fish. Quarterly price and quantity data for these goods are examined at retail for 1967 through 1987. A linear version of the almost ideal demand system (AIDS) model was estimated. The model was estimated using first differences and an interactive, seemingly unrelated regression procedure which converges to a maximum likelihood estimator. The model estimated provides a transition function to identify a structural change path. Structural change was allowed to affect all parameters simultaneously. The results suggest a structural change took place between the fourth quarter of 1975 and the third quarter of 1976, indicating a fairly rapid transition to a new demand regime. The authors examined estimates of elasticity but could not find statistically significant evidence to indicate elasticities have changed. In this finding, the authors suggest that emphasizing the effect of structural change on estimated elasticities may be unjustified. As an alternative to examining elasticities, the authors suggest focusing on biases in consumption patterns. By examining expenditure shares, a measure of bias was developed. Their analysis suggest the presence of a significant bias against beef in favor of chicken and fish, resulting from structural change. Structural change was found to be neutral on pork.

**Eales, James S. and Laurian J. Unnevehr.** "Demand for Beef and Chicken Products: Separability and Structural Change." *American Journal of Agricultural Economics*. Vol. 70, No. 3. August 1988. pp. 521-532.

This article addresses two questions. First, do consumers choose among broad groups of meats or meat products? If they choose among products, meats need to be disaggregated into their constituent products. Secondly, does disaggregation of meat into products in a meat demand model provide insight into causes of structural change? The authors employed Deaton and Muellbauer's Almost Ideal Demand System to answer these questions. The models were estimated with annual data covering the period 1965-1985. Their results suggest that consumers choose across all meat products at once or possibly among high quality and low quality

products of different meats. This suggests the use of aggregate chicken and beef in demand analysis could create bias in estimated demand parameters. The authors suggest a preference change has occurred since 1974 that has resulted in the substitution of chicken parts for beef table cuts. The preference change has apparently been motivated not by health concerns but by product convenience.

**Dahlgran, Roger A.** "Changing Meat Demand Structure in the United States: Evidence From a Price Flexibility Analysis." *North Central Journal of Agricultural Economics*, Vol. 10, No. 2. July 1988. pp. 165-176.

This study sought to determine whether possible changes in consumer preferences for different types of meats have caused structural changes in U.S. meat demands. The author takes a less restrictive view of structural change in that he suggests structural change occurs whenever the parameters of an economic model change a small number of times in response to forces within or outside of the model, providing the model is consistent with the theory of constrained utility maximization. Multi-equation price dependent models, producing price flexibilities, are estimated using annual data for 1950 through 1985. Weak separability was assumed and thus price and quantity data at retail were examined for beef, pork, chicken, and implicitly a fourth commodity - "all other foods". Plots of cumulative sum of squares (CUMSUMSQ) were used to detect evidence of structural change. This analysis suggested evidence of structural change taking place in the 1973-77 period. The author examined the 1951-72 time period and the 1977-85 time for evidence of behavioral structural change between the two periods and variance of structural change between the two periods. Using the likelihood ratio tests, strong statistical significance was found for concluding that both behavior and variance changes are present. During the latter period examined, higher cross price flexibilities for beef, pork, and chicken were found. The author suggests that the finding implies consumers now view these meats as closer substitutes. The finding of increased meat demand variability implies that beef and pork demand will be more variable than they were previously. This factor suggests adjustments in the meat producing, processing, and retailing sector are required to manage increased price risks in marketing red meats.

**Helen, Dale, and Greg Pompelli.** "The Demand for Beef Products: Cross-Section Estimation of Demographic and Economic Effects." *Western Journal of Agricultural Economics*, Vol. 13, No. 1. July 1988. pp. 37-44.

The approach to meat demand analysis in this paper is to analyze demand for specific cuts of beef. The specific cuts analyzed were steak, roasts, and ground beef. The authors made use of the 1977 USDA Household Food Consumption Survey data to conduct their estimation. Use of this data set allowed for conclusions to be drawn regarding demographic effects on the demand for these beef products. An Almost Ideal Demand System (AIDS) was estimated for this analysis. Demographic effects were incorporated into the system through specifying the intercept as a linear function of demographic variables. The results indicated the demand for steak and ground beef was inelastic while the demand for roast was elastic. An increased proportion of black or Hispanic households increased the demand for steak and decreased the demand for ground beef. Demand for roasts was inversely related to the proportion of Hispanic households and directly related to the proportion of black households. The employment status of the female head in the household was not significant nor was the sex of primary food shoppers. Household size was inversely related to demand for steak and roast and positively related to demand for ground beef.

**Moen, Daniel S. and Oral Capps, Jr.** "A Nonparamatic Analysis of Consumer Preferences for Fresh Meat Products." *Texas Agricultural Experiment Station*, Technical Article No. 23595, College Station, TX. June 1988. 11 pages.

This paper reports on a study that examines qualitative factors related to consumer demand of fresh meats. Eight fresh meats (beef steak, beef roast, ground beef, pork, lamb, chicken, turkey, and fish) are examined for frequency of purchase and consumer preference based on taste and quality. Data analyzed was from a telephone survey of 200 shoppers from a retail firm in Houston, Texas during the second quarter of 1987. The demographic profile of the individuals in the survey suggests the sample is not representative of any particular region. The sample was dominated by college educated individuals with above average incomes between the ages of 30 to 39 coming from a household of two to three members. The analysis was conducted using Kruskal-Wallis tests and Dunn's multiple comparison procedures. Analysis of frequency of purchases produced the following order from most frequent to least frequent: chicken, ground beef, fish, beef steak, pork, beef roast, turkey, and lamb. Taste and quality ratings were more ambiguous. Chicken and beef steak were pre-

ferred over ground beef, turkey, pork, and lamb. Fish and beef roast were preferred over turkey, pork, and lamb. No preference rating between chicken, fish, beef steak, and beef roast was identified. Lamb was the lowest rated fresh meat based on the taste and quality analysis. Along with providing objective nutritional information, the authors suggest the industry needs to focus on product leanness, convenience, and ease of preparation.

**Dahlgran, Roger A. "Complete Flexibility Systems and the Stationarity of U.S. Meat Demand." *Western Journal of Agricultural Economics*, Vol. 12, No. 2. December 1987. pp. 152-163.**

This paper investigates the role of economic variables in explaining the historical changes in meat consumption patterns using a complete Rotterdam demand system. Annual data from 1950 through 1985 for beef, pork, chicken, and other food is used in the estimation of the system. The time path of possible structural change is studied by including a structural change regression model. Using either a logit variable or an exponential variable to represent structural change, the results of the analysis indicates that the changes in demand system parameters were consistent with increased substitutability between beef and chicken, but these changes in the early 1970s were transitory and do not provide evidence of a permanent change in consumer's preferences. The results indicate that the meat demand elasticity structured changed in the 1970s but re-established itself in the 1980s, suggesting the 1970s structure was an aberration. Analysis of price flexibilities suggest prices in the 1980s will vary more due to supply changes than in the 1960s.

**Skaggs, Rhonda K., Dale J. Menkhaus, Steven J. Torok, and Ray A. Field. "Test Marketing of Branded Low Fat, Fresh Beef." *Agribusiness: An International Journal*, Vol. 3, No. 3. Fall 1987. pp 257-271.**

This article reports on a test marketing study of a branded, lean, fresh beef product. The test marketing was conducted using laboratory test markets by the market research firm of Yankelovick, Skelly, and White in the San Francisco Bay area during the fall of 1985. The objective of the laboratory test market was to examine the appeal of a branded, lean, fresh beef product in comparison to the typical beef products purchased by consumers. While not the direct intention of this study, the study does provide insight into areas of consumer tastes and preferences as related to the demand for meat. The test beef was from 1,000 to 1,100 pound, grass-fed steers producing either a Good or Standard yield grade 1 or 2.

The control beef was quality grade of Good and a yield grade of 2, trimmed to .3 inch of external fat. For test purposes, the laboratory market test was conducted with the price per pound the same for the test and control beef. The results of the tests indicate consumers are concerned with freshness, leanness, and appearance. Consumers were concerned about fat content and leanness, and indicated a receptiveness to a lower fat, lean product. Informing consumers through marketing support of nutritional aspects and claims of low-fat beef and natural products stimulated sales. The research found evidence that consumers were willing to adapt or compromise standards on taste and palatability if the product is leaner and more nutritious. This study highlights the importance of tastes and preferences in the consumer's buying decision.

**Hahn, William F.** "Measuring the Effect of the Distribution of Income Upon Consumer Demand for Meats." Presented Paper, American Agricultural Economics Association Annual Meeting, East Lansing, Michigan, August 1987.

This paper examines the impacts of shifts in the distribution of income on the demand for meats. The researcher encounters a problem of aggregation bias because of the limited available information on distribution of income. The moment generating function of the logarithm of income is employed. The author used annual CPI deflated income and a ratio of mean and median family income and the unemployment rate data for 1960-1984. Time trends were explicitly incorporated in the model to prevent income distribution from coincidentally picking up trends. Hahn submits that aggregation bias will decrease the income elasticity for beef and increase the income elasticity of demand for chicken. Using the moment generating technique to correct for aggregation bias and incorporating the variable mentioned above should improve demand estimation.

**McCracken Vicki A. and Jon A. Brandt.** "Household Consumption of Food-Away-From-Home: Total Expenditure By Type of Food Facility." *American Journal of Agricultural Economics*. Vol. 69, No. 2. May 1987. pp. 274-284.

The authors examine the influence of the downward trend since the 1960s in at-home expenditures as a percentage of total food expenditures. An attempt is made to identify what forces influence where the away from home expenditures are made and the authors seek to link the type of food facility with household income, value of time, and household size. The data source for the research is the 1977-78 Nationwide Food Consump-

tion Survey (USDA). Tobit analysis was used rather than OLS because many households had zero expenditures on food away from home during the survey period. Total food away from home expenditures were examined as well as expenditures at restaurants, fast food facilities, and other commercial facilities. The findings suggest that individuals eat at restaurants for reasons aside from saving time and eating at fast food facilities depends less on income than on value of time. The researchers suggest that marketing efforts of the food service sector should focus on larger household and the middle income class, the groups that provide the greatest potential for the industry.

**Buse, Reuben C., editor, *The Economics of Meat Demand*, Conference Proceedings, Charleston, SC. October 20-21, 1986. 375 pages.**

This book is a compilation of papers presented at a "demand conference" at Charleston, South Carolina in August of 1986. Topics range from largely conceptual discussions of what constitutes a shift in demand and how such shifts can be identified to reports of empirical results of analysis. The "almost ideal demand system" approach to modeling demand is covered, and the need to consider all foods (or all expenditures) at the consumer level is discussed and demonstrated. This is a useful reference for a professional economist who works in this area and for private sector professionals who conduct demand analyses and/or need to stay abreast with the latest methodology and analytical technique.

**Capps, Oral, Jr. and Benjamin Senaver, eds. "Food Demand Analysis Implications for Future Consumption." S-165 Southern Regional Research Committee and the Farm Foundation. Department of Agricultural Economics, Virginia Tech, Blacksburg, VA. August 1986. 292 pages.**

This book is a collection of 15 papers dealing with food demand issues with implications for future consumption. The book is edited by Capps and Senaver and was sponsored by the Southern Regional Research Project S-165 and the Farm Foundation. The papers and authors presented in this book are:

1. *Market Demand Functions.* S. R. Johnson, Richard A. Green, Zuhar A. Hassan and A. N. Safyurtlu.
2. *Global Behavior of Demand Elasticities for Food: Implications for Demand Projections.* Michael K. Wohlgenant.
3. *Food Expenditure Patterns: Evidence From U. S. Household Data.* Chung L. Huang and Robert Raunika.



4. *Projecting Aggregate Food Expenditures to the Year 2000.* Kuo S. Huang and Richard C. Haidacher.
5. *Implications of Factors Affecting Food Consumption.* Robert Raunika and Chung L. Huang.
6. *Is the Structure of the Demand for Food Changing.* Reuben C. Buse.
7. *The Effects of Household Size and Composition on the Demand For Food.* David W. Price.
8. *Role of Integrated Decision Theory in Considering Future Food Consumption Patterns of the Elderly.* Dorothy Z. Price.
9. *Effects of Increasing Elderly Population on Future Food Demand and Consumption.* Ronald A. Schrimper.
10. *Comments: Food Demand Analysis: Implications for Future Consumption.* Lester H. Myers.
11. *Population Scale, Composition, and Income Effects on Per Capita and Aggregate Beef Consumption: A Temporal and Spatial Assessment.* Patricia K. Guseman and Stephen G. Sapp.
12. *Orange and Grapefruit Juice Demand Forecasts.* Mark G. Brown and Jong-Ying Lee.
13. *Analysis of Convenience and Non-convenience Food Expenditures by U.S. Households With Projection to the Year 2000.* Oral Capps, Jr. and Joanne M. Pearson.
14. *A Systematic Analysis of Household Food Consumption Behavior with Specific Emphasis on Predicting Aggregate Food Expenditure.* James C. O. Nyankor.
15. *Implications for Food Demand of Changes in Competitive State Within Marketing Channels.* Barry W. Bobst.

Reed, Michael R. and Lynn W. Robbins. "The Relationship Between Managerial Heuristics and Economics in Pricing Retail Meats." *Southern Journal of Agricultural Economics*. Vol. 18, No. 2. December 1985. pp. 87-95.

Reed and Robbins develop a theoretical model of retail pricing of meat products. The authors examine two hypothesis concerning store level retail pricing of meat. First, because consumers react differently to price changes of products depending on how often they purchase the product and the share of total expenditures the product accounts for, the elasticity of price transmission depends on the nature of the product. Secondly, retailers attempt to spread retail price change resulting from wholesale price changes over time. These hypotheses were tested on data from two supermarket chains in Lexington Kentucky on a weekly basis for six different meat items between February 1981 and February 1982. Three-stage least square estimation was used for the six individual product

regressions. On a weekly basis, no evidence was found to support a link between wholesale prices and retail prices and prices in week  $t$  were found to be poor predictors of the price in week  $t + 1$ . The analysis indicated that for the more expensive cuts, retail prices adjusted much more slowly to wholesale price changes than for the less expensive cuts. Even in the long run, changes in wholesale prices are not totally passed on to the consumer for expensive and inexpensive meat cuts.

**Wohlgenant, Michael K.** "Estimating Cross Elasticities of Demand for Beef." *Western Journal of Agricultural Economics*. Vol. 10, No. 2. December 1985. pp. 322-329.

Wohlgenant analyzes structural change in demand for beef in light of the Chavas and the Moschini-Meilke studies. In order to avoid specification bias that the author suspects in the two similar studies, he employs the semi-nonparameters methodology of the Fourier flexible form. The analysis uses annual time series data covering the period 1947-1983. Per capita consumption for beef is specified as a function of per capital income; retail prices of beef, pork, poultry and fish; and retail prices of non-meat consumer goods. The variables were transformed to logarithmic form. Wohlgenant found little evidence of own-price elasticity changes for beef or increases in cross price elasticity with respect to poultry through the 1970's. Wohlgenant suggests findings of structural change in the Chavas and Moschini-Meilke studies were the result of misspecification, and that changes in quantity demanded for beef can be attributed to changes in real meat prices and real income.

**Huang, Kuo S.** "Monthly Demand Relationships of U.S. Meat Commodities." *Agricultural Economics Research*, ERS-USDA. Vol. 37, No. 3. Summer 1985. pp. 23-29.

This article examines monthly demand for meat and incorporates a monthly demand framework into forecasting meat prices. An inverse demand relationship (price at which consumers will buy a given quantity) is formulated. This formulation is relevant for meat demand in the short run given the time frame required to adjust supply. The author assumes quantities and income are fixed which implies that meat prices must adjust to clear the market. Data employed were monthly price observations for five beef products and four pork products from the U.S. Department of Labor, Bureau of Labor Statistics and monthly price observations for broilers and per capita quantities for meats from Economic Research Service, USDA, for the period January 1964 to December 1979. Demand

flexibilities were estimated using a log linear estimation technique. Monthly variation was identified using a set of monthly binary dummy variables with January as the base. The author concludes the seasonal high in prices for beef is July and August with lows in December and April. Pork prices peak in March and bottom out in the May-July period. Broiler price peaked in July and bottomed out in November. In addition, the statistical estimates suggest that broilers are a significant substitute for pork, but no significant relationship was found between broilers and beef.

**Moschini, Giancarlo and Karl D. Meilke.** "Parameter Stability and the U.S. Demand for Beef. *Western Journal of Agricultural Economics*. Vol. 9, No. 2. December 1984. pp. 271-282.

This article examines whether changes in consumer's preferences have taken place in the demand for beef. This hypothesis is tested by examining parameter stability in estimated demand equations. Per capita consumption for beef was regressed on the retail price of beef, the retail price of pork, a price index for all other relevant goods, and an income variable. Alternative specifications of the demand function were estimated using a general form of the Box-Cox transformation. Tests of parameter stability involved Chow tests, and Farley-Hinich tests, both based on f-tests and on analysis of recursive residuals. The demand functions were estimated for 1966-1981 with subsets of 1966-1973, and 1966-78. There was some evidence that there was structural change in demand around 1973, but the authors suggest no strong conclusion can be formed. If parameter changes took place, they were confined largely to price coefficients.

**Capps, Oral, Jr. and Joseph Havlicek, Jr.** "National and Regional Household Demand for Meat, Poultry and Seafood: A Complete System Approach." *Canadian Journal of Agricultural Economics*. Vol. 32, No. 1. March 1984. pp. 93-108.

The purpose of this paper was to identify and assess selected factors that affect the household demand for meat, poultry and seafood at a regional national level. A generalized linear expenditure system based on the Brown-Heien S(1) branch system was used. This system is based on a direct utility function consistent with traditional demand theory. Data from the 1972-74 U.S. Bureau of Labor statistics Consumers Expenditure Diary Survey were used. The geographical breakdowns were the United States, the Northeast, the North Central, the South, and the West. Demographic characteristics examined were urban and non-urban communities and household size. The results indicated that pork and seafood

purchases were most sensitive to household size, and all meat, poultry and seafood purchases were significantly and positively related to household size. The authors concluded meat, poultry and seafood purchases were very sensitive to own-price changes, changes in household size, total expenditure sales, and urbanization and regional location. Though of less sensitivity, cross price changes were important and consistent with economic theory.

**Crom, Richard.** "Effects of Simulated Changes in Consumer Preference on the Meat and Poultry Industries." *Agricultural Economics Research*, ERS-USDA. Vol. 36, No. 2. Spring 1984. pp. 16-24.

In this study, the author attempts to simulate the effect of four scenarios to measure the impact of alternative hypothesis regarding changing consumer preferences for beef, pork, and chicken. If consumer preferences for these meats have changed, then it will still be several years before statistical analysis will confirm the shift. The USDA Food and Agricultural Policy Simulator (FAPSIM) was used for this analysis. The first scenario tested was a decline in consumer preference for all three meats. This was tested by reducing all retail prices by one percent each year for 10 years. The results indicate, at the end of 10 years, a 15 percent decline in retail pork prices, a 25 percent decline in chicken prices, and a 17 percent decline in retail beef prices. The livestock inventory declines, resulting in less demand for feed grains. Farm income declines 29 percent by the 10th year though profitability of livestock production was not as severely effected because feed prices dropped. The second scenario simulated a decrease in preference for beef and an increase in preference for poultry. The result of this simulation was that beef prices fell 11 percent over 10 years, pork price dropped three percent, and chicken price managed a one percent increase at the end of the 10 years. Scenario three saw a decrease in preference for beef and pork and an increase in preference for chicken. Beef and pork prices drop 14 percent and 1 percent respectively and, at the end of 10 years, even though chicken preference had increased, price was pulled down five percent. The fourth scenario increased the preference for beef. This simulation resulted in an increase in income for farmers because of higher consumer prices and a small increase in supply.

Huang, Kuo S. and Richard C. Haidacher. "Estimation of a Composite Food Demand System for the U.S." *Journal of Business and Economic Statistics*. Vol. 1, No. 4. October 1983. pp. 285-291.

A statistical procedure is developed for computing simultaneously the parameters for a complete demand system. The procedure is then applied to the estimation of consumer demand for U.S. composite food categories and a variable representing the nonfood sector. The approach used requires that less than half of the demand parameters are estimated directly. A constrained maximum likelihood method with parametric restriction, based on classical demand theory, is incorporated into the estimation process by substitution. For a large demand system model, this approach economizes on computing time and capacity. In an empirical estimation the following 12 composite food categories were estimated for the period 1950-1981;

1. Meat
2. Poultry
3. Fish
4. Eggs
5. Dairy Products
6. Fats and Oils
7. Fresh Fruits
8. Fresh Vegetables
9. Processed Fruits and Vegetables
10. Cereal and Bakery Products,
11. Sugar and Sweeteners
12. Nonalcoholic Beverages.

Based on a root-mean square error test of prediction on quantity demanded over the sample period, the error was roughly 4 percent. The estimated own-price elasticity from the constrained model was -.5259 for meat and -.6753 for poultry. The unconstrained model estimation of own-price elasticity for meat was -.4188 and -.5700 for poultry. The authors suggest that a composite demand system provides information about the complete interdependent nature of demand for food, which traditional partial demand analyses cannot provide.

**Haidacher, Richard C.** "Assessing Structural Change in the Demand for Food Commodities." *Southern Journal of Agricultural Economics*. Vol. 15, No. 1. July 1983. pp. 31-37.

This paper provides an overview of the rules that govern the demand for food and how the demand structure can be assessed for possible changes. The author discusses problems associated with obtaining direct evidence of structural change and proposes an indirect approach that may provide useful information on structural change. Demand structure is defined as a set of parameters that form the function  $f(1), \dots, f(n)$  that are uniquely specified by the utility function  $U = F(q)$ . The model refers to the individual consumer, but food demand analysis is concerned with an aggregate level and thus aggregate demand is assumed to be represented by the same model. Basically, a demand system will encompass the spectrum of commodities in the consumers budget (income) and a demand function for each commodity. Haidacher points out that the preference function is not directly observable and therefore changes in that function are not observable. In addition, our methods for assessing changes in demand are flawed. Haidacher states that we start with a "Maintained Hypothesis" which represents our assumed demand structure, and an "Alternative Hypothesis." Rejection of the Maintained Hypothesis based on statistical tests implies the acceptance of the Alternative Hypothesis. In fact, there can be numerous Alternative Hypothesis candidates rather than one. Because of the intractable nature of obtaining direct evidence of structural change, Haidacher suggests using an indirect approach. One such approach is to estimate the linear expenditure system and use the estimated error between actual and simulated values as a rough approximation of the magnitude of possible structural change. Haidacher provides additional suggestions including: (1) extend the validation outside the period used to estimate the structure, (2) incorporate dynamic aspects in the basic demand structure such as durable goods, and (3) incorporate contemporary developments on time-variant parameters.

**Wohlgenant, Michael K.** "Discussion: Assessing Structural Change in the Demand for Food Commodities." *Southern Journal of Agricultural Economics*. Vol. 15, No. 1. July 1983. pp. 39-41.

This article is a discussion of the Haidacher effort (Southern Journal of Agricultural Economics, July 1983.) Wohlgenant adds to Haidacher's definition of demand structure the opportunity set facing consumers and composition of the population of consumers. Opportunity sets need to be included because in some instances the budget constraint may be nonlinear, such as when the household is both consumer and producer of the

commodity. Composition of population is important because when working with aggregate data, the general restriction of consumers behavior only apply to individual consumers. Wohlgenant emphasizes that inclusion of household production theory in explaining demand behavior may provide greater insight into demand structure.

**Chavas, Jean-Paul.** "Structural Change in the Demand for Meat." *American Journal of Agricultural Economics*. Vol. 65, No. 1. February 1983. pp. 148-153.

Chavas develops a method for testing whether structural change for meat demand was taking place. A linear model is the base of this investigation. The data used was per capita consumption of poultry, beef, and pork, per capita disposable income, and retail prices for poultry, beef, and pork, and a price index of goods from 1950 through 1979. The analysis was completed in two steps. The model was estimated for 1950-1970 to develop prior information on demand elasticities. This information was then used to investigate structural change in the 1970's. Chavas concluded that structural change for poultry and beef took place in the late 1970's. Income elasticity for beef decreased from +.655 in 1975 to +.183 in 1979, and the own-price elasticity changed from -.870 to -.617 for the same period. During the 1975 to 1979 period, the income elasticity of poultry increased from +.012 to +.275, and the cross-elasticity between poultry and pork decreased from .185 to .001.

**Haidacher, Richard C., John A. Craven, Kuo S. Huang, David M. Smallwood, and James R. Blaylock.** "Consumer Demand for Red Meats, Poultry, and Fish." USDA-ERS, NEA. AGES 820818. September 1982.

Haidacher et al used a complete demand system approach in analyzing demand for meats in the U.S. They go from an aggregate level of demand for food and disaggregate down to the consumption of individual meats. The theoretical constructs behind the analysis is traditional consumer demand theory with consumption decisions related to other commodities or items and constrained by the consumer's budget. This implies that the quantity demanded is determined by the price of a good and price of every other good and income. The aggregate demand for food was estimated for the period 1955 to 1981 while the disaggregated analysis of food was estimated for 1950 through 1977. Cross-sectional analysis of food demand was based on data from the 1977-78 Nationwide Food Survey. The results of this analysis suggest that the overwhelming part of the variation in U.S. meat consumption is explained by changes in retail prices and

consumers' income. The researchers conclude that the demand relationship for meat in the U.S. is characterized by a large degree of inherent stability. In addition, they conclude that at the aggregate and disaggregate level, food and meat are income inelastic. Their analysis of cross-sectional data indicated "at-home" consumption of total red meat and poultry and fish is unresponsive to income, but higher priced meats and highly processed meat items are responsive to income levels.

**Leuthold, Raymond M. and Ethelbert Nwagbo. "Changes in the Retail Elasticities of Demand for Beef, Pork, and Broilers." *Illinois Agricultural Economics*. July 1979. pp. 22-27.**

This paper examines whether the quantities demanded of beef, pork, and broilers have become less responsive to price changes through time. Leuthold and Nwagbo review the literature in this area and present the basic theoretical constructs required for their estimation of price, cross and income elasticities for monthly and quarterly demand relationships. Their basic hypothesis was that as American consumers become more affluent, they become less responsive to price. The analysis was conducted over the years 1964 through 1975. For beef, they found evidence of demand becoming more inelastic around 1969 but the evidence was not statistically strong enough to be conclusive. For pork, there was evidence that demand was becoming less inelastic over time but they could not statistically confirm this. The authors were unsuccessful in developing significant demand relationship for broilers, particularly for the 1972-75 subperiod. The statistical tests used for indicating demand shifts were the Chow Test and the Chow-Fisher test.

**Funk, T. F., Karl D. Meilke and H. B. Huff. "Effects of Retail Pricing and Advertising on Fresh Beef Sales." *American Journal of Agricultural Economics*. Vol. 59, No. 3. August 1977. pp. 533-537.**

This study examined the influence of newspaper advertising on the demand for beef. The analysis was performed at the level of individual supermarket chains for metropolitan Toronto between January 1974 and May 1975. Newspaper advertising was examined because it constituted 60 percent of beef advertising expenditure and it was the only medium in which specific products were highlighted. The data used were weekly sales levels of beef, weekly prices for beef and other meats, and weekly newspaper advertising for beef and other meat products. A single equation (OLS) approach was used. The researchers justified this on the basis of supply being perfectly elastic for a small local market within the



North American beef industry. Higher quality cuts were found to be more price elastic. No definitive conclusions were reached concerning the effect of advertising and specials on certain cuts, but evidence of a positive relationship between advertising and specials on sales of individual cuts was found. In general, advertising of pork tended to have a negative effect on beef sales and other meat advertising had a positive effect. Advertising elasticities were in general substantially lower than price elasticities. The advertising of meat by competitors was not found to exert a significant influence on sales of the supermarket chains.

**Chang, Hui-Shyong.** "Functional Forms and the Demand for Meat in the U. S." *The Review of Economics and Statistics*. Vol. 59, No. 3. 1977. pp. 355-359.

In this note, Chang reviews the impact that the functional form specification in demand analysis will have on estimates of elasticity. The log form implies constant elasticities whereas a linear form will imply an elasticity that is rising. Chang employs a general functional form using the Box-Cox maximum likelihood procedure. Chang lays out the mathematical formulation showing that a log form will result in a constant elasticity and a linear specification will result in an increasing elasticity. By using a maximum likelihood transformation, these two implications can be avoided. Chang estimates his model on annual time series data for per capital consumption of meat (beef, pork, veal, lamb and mutton), per capita real income, price of meat/price of food, from 1935 through 1974 with 1942 through 1947 excluded because of the influence of World War II. The estimated elasticity of demand for meat from the general form was  $-.62$ , while the log form resulted in an estimate of  $-.53$  and the linear form  $-.44$ . Chang points out that while income increased from \$1,035 in 1935 to \$2,846 in 1974, the income elasticity estimate from the linear form went from  $.351$  to  $.606$ , the log form provided a constant estimate of  $.493$ , and the general form decreased from  $.647$  to  $.402$ . The results of the general form are consistent with economic theory.

Purcell, Joseph C. and Robert Raunika. "Price Elasticities from Panel Data: Meat, Poultry and Fish." *American Journal of Agricultural Economics*. Vol. 53, No. 2. May 1971. pp. 216-221.

Purcell and Raunika contend the inability of agricultural economists to estimate specific price-quantity relationships is a result of inadequacy of data necessary to estimate the relationships. Generally, the data used are time series of national aggregate data. They suggest that these data result in:

1. A limited range in postulated explanatory variates,
2. Multicollinearity in explanatory variates,
3. Lagged adjustment in response, and
4. Gross averages for long time periods that conceal many individual changes.

In order to address these concerns, Purcell and Raunika estimated demand relationships for meat, poultry and fish based on weekly data collected from 300 households in Atlanta from 1958-1962. Their analysis indicated that except for poultry meat, purchases were not significantly responsive to changes in price of substitutes.

## **Livestock Price Discovery**

**Rhodus, W. Timothy, E. Dean Baldwin, and Dennis R. Henderson.** "Pricing Accuracy and Efficiency in a Pilot Electronic Hog Market." *American Journal of Agricultural Economics*, Vol. 71, No. 4. November 1989. pp. 874-882.

The price performance of an experimental electronic market for hogs is compared with a terminal market and a direct market. The price levels delivered by the electronic market and the previous and subsequent market alternative were also examined. The Hog Accelerated Marketing System (HAMS) was operated in Ohio between November of 1979 and June of 1980. The Hog prices increased \$.94 to \$.99 per hundredweight during the operation of the HAMS experiment. Pricing efficiency was measured by two methods, a measure of frequency of price changes and a measure of average price changes. In comparison with the Peoria terminal market and the Indiana direct market, the frequency of price change indicated that HAMS was a more efficient market. The average price change measure indicated that HAMS was statistically more efficient than the Peoria terminal market. This result was not statistically confirmed when comparing the average price changes measured for HAMS and the Indiana direct market. The authors suggest that the HAMS experiment indicates that electronic trading is effective at enhancing competition and improving price efficiency.

**Bailey, Deevon and Monte C. Peterson.** *Price and Basis Implications of Video Cattle Auctions.* Research Institute on Livestock Pricing, Research Bulletin 3-89, Agricultural Economics, Virginia Tech, Blacksburg, VA. November 1989. 19 pages.

Video cattle auctions are compared to large regional feeder cattle auctions in this study. The objective is to analyze the performance of video cattle auctions and to investigate factors affecting prices in video auctions. Data were examined for the 1987 Superior Livestock Auction in Brush, Colorado. The regional auction markets examined were the Greeley, Colorado market and the Oklahoma City, Oklahoma market. Tests for price differences between the video auction and the regional auction suggest that the video auction provided prices \$.34 per cwt. above midpoint reported prices for the Oklahoma City market and \$1.38 per cwt. above the midpoint price for the Greeley market. When the high report market price was compared, there was no statistically significant difference between the video auction and Oklahoma City market prices. For the Greeley market, the video auction price was greater by \$.75 per cwt., a

statistically significant increase. The authors suggest that these price differences are the result of informational and structural differences between video auctions and regional auctions. The analysis found factors such as lot size, origin of cattle, and accuracy of weight to be important to prices offered for cattle. Factors such as offering a slide discount for inaccurate weight reports was found to be an attractive merchandising strategy for video auction cattle.

**Marsh, John M. "Effects of a Beef Grade Change on Choice and Select Slaughter Cattle Prices." *North Central Journal of Agricultural Economics*, Vol. 11, No. 2. July 1989. pp. 221-232.**

This paper examines the expected impact that a revision of the USDA Choice and Select grading requirements would have on slaughter prices. The simulated revisions to grades would allow a fixed percentage of Choice to be moved into the Prime grade and a respective percentage of Select and ungraded beef to be moved into the Choice grade. The author estimated geometric distributed lagged models for Choice grade slaughter steers and Select grade slaughter steers in Omaha respectively. The models were estimated using quarterly data for 1976-1985. The estimated models provide information on the relationship between steer prices and cattle of different grades and additional relevant economic variables. The net result of a revision of grades, as simulated in this study, would be to reduce Choice steer prices and increase Select steer prices, thus reducing the discount of Select steers relative to Choice steers. The inclusion of ungraded beef in this analysis is important because the analysis demonstrates that ungraded beef impacts on steer prices and that the role of ungraded beef could bias estimates of grade impacts on live cattle prices if ungraded beef is ignored. The author notes that for public grades to provide price benefits to producers, they must increase primary demand as consumers perceive they are better off.

**Kahl, Kandice H., Michael A. Hudson, and Clement E. Ward. "Cash Settlement Issues for Live Cattle Futures Contracts." *Journal of Futures Markets*, Vol. 9, No. 3. June 1989. pp. 237-248.**

This article examines the issues relevant to cash settlement of the CME live cattle futures contract. The authors specifically list three criteria that must be satisfied for a change to cash settlement to improve a futures contract. The change to cash settlement must reduce basis variability, the cash price series used for cash settlement must be an accurate representation of cash market values, and the cash price series must be free from

the potential for manipulation. For data from January 1980 through December 1986, seven alternative cash price index-basis relations were simulated and variances were estimated. This analysis indicated that a Cattle Fax index would consistently reduce basis variability. Based on this finding, the authors presented a discussion of how accurate a representation of cash market values the Cattle Fax index is. Concern over the accuracy of the Cattle Fax index stems from the influence that an individual outlier sale could have given that sellers of cattle are contacted to obtain price information. An effective audit program of reported transactions would be difficult to maintain. For this analysis, the authors define manipulative influences as the ability of one firm or a small group of firms to behave in a manner that changes market price in their favor. With regard to the potential for manipulative influence of a cash price index, no definitive answer is available. The authors provide the caveat that given increased concentration in the buyers of fed cattle and increased vertical integration, the possibility for manipulative behavior in the cash market for fed cattle increases.

**Rowse, John B., Michael A. Hudson, and Raymond Leuthold. *Commercial Use and Speculative Measures of Livestock Futures Markets Revisited*. Proceedings, NCR-134 Conference, Applied Commodity Price Analysis, Forecasting, and Market Risk Management. April 20-21, 1989. pp. 104-118.**

This paper examines the relationship between physical and economic market variables and the composition of traders in the CME live cattle contract. Composition of trade data from the CFTC was augmented with monthly market data for prices of relevant inputs and outputs, and with relevant supply and disposition data for the period 1970 through 1987. A review of trends in the data indicate that trading volume in the live cattle futures grew through the 1970s into the 1980s. Relative to all futures trading on the CME, live cattle volume peaked in 1974 at 55.2 percent of total volume and represented only 6.3 percent of total volume in 1987. Composition of traders was relatively stable. There was a large drop in the 1980s of reporting, long-speculative positions held but this was compensated for by significant growth in the reporting, long-commercial positions held. Evidence of structural change in the composition of traders in the live cattle futures was found. Large-reporting speculators appear to have left the market. While no statistical significant results were obtained when binary variables were used to represent contract innovations such as change in contract specifications, the certificate of delivery and options on live cattle futures, models estimated indicated structural change in the period after those innovations. The results reported in this

paper suggest that futures contracts may have a life cycle similar to those present in product markets, and traders that build and establish futures contracts may be different from the ones that sustain the market.

**Oellermann, Charles E., B. Wade Brorsen, and Paul L. Farris. "Price Discovery for Feeder Cattle." *The Journal of Futures Markets*, Vol. 9, No. 2. April 1989. pp. 113-121.**

This article examines the price leadership relationship among cash and futures prices for feeder cattle. The analysis was conducted using daily closing pricing for the nearby feeder cattle and live cattle contract on the CME and average daily cash prices for feeder steers and slaughter steers from the Oklahoma City and Omaha markets. The period analyzed was 1979 through 1986. The time period was divided into two sub-periods, 1979-82 and 1983-86. Causality tests were conducted on the price differences between Monday-Tuesday prices and Tuesday-Wednesday prices. Granger causality tests were conducted to identify lead-lag relationships and a dynamic regression testing scheme was applied to investigate price leadership relationships between cash and futures prices. The results of the Granger causality analysis indicated that for feeder cattle, the futures price led the cash price. The strength of this lead was less during the 1983-86 time period than it had been in the 1979-82 period. The results suggested that the futures price leads the cash price in incorporating new price information.

**Hudson, Michael A., Thomas A. Hieronymus, and Stephen R. Koontz. "Deliveries on the CME Live Cattle Contract: An Economic Assessment." *North Central Journal of Agricultural Economics*, Vol. 10, No. 2. July 1988. pp. 155-164.**

Economic factors affecting the level of deliveries made on the CME live cattle contract were examined in light of the modifications made in the delivery process and contract specifications. In addition, differences in regional delivery patterns are examined. The authors present a discussion of the conceptual dimension of delivery and relate this to factors expected to influence deliveries on the live cattle contract. The empirical analysis is conducted by estimating functions to explain deliveries for January 1975 through April 1985 using ordinary least squares. Three functions were estimated - total deliveries, deliveries made east of the Mississippi River, and deliveries west of the Mississippi River. The results from the total deliveries function showed basis affected deliveries as did the discount between Yield Grade 3 and Yield Grade 4 prices, and limited sea-

sonal influences were apparent. Modifications to contract specifications that limited deliveries of Yield Grade 4 animals appeared to have a significant influence on reducing deliveries. The certificate of delivery did not have a statistically significant effect on deliveries, though the authors note this system was only in place for 9 of the 63 delivery periods examined. The spread between maturing contract prices and the next nearby contract did not appear to be an important factor in the delivery process. Deliveries in the eastern markets were found to respond to delivery month basis, the spread between the maturing contract and the next nearby futures contract. Price discounts between Yield Grade 3 and Yield Grade 4 animals were not significant in deliveries in eastern markets. It is of interest that the authors found the certificate of delivery variable to have a significant and negative impact on deliveries in the eastern markets. Deliveries in the western markets were consistent with the results for all deliveries though no seasonal patterns were found.

**Koontz, Stephen R., Michael A. Hudson and Philip Garcia. "Dominant-Satellite Relationships Between Futures and Selected Cash Prices for Live Cattle." NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management. Chicago, Illinois, April 22, 1987. pp. 331-345.**

This paper examines the lead/lag relationship among major cash markets for cattle and live cattle futures prices. The classification of dominant and satellite markets is derived from the possibility that one market leads others in the price discovery process. The dominant-satellite relationship between markets (cash and cash, cash and futures) was examined using Granger causality. The overall period examined was January 1973 to December 1984 with three subperiods within these bounds. The data examined were weekly cash prices for fed cattle and a truncated nearby Chicago Mercantile Exchange live cattle futures price. During the latter two time periods (1977 through 1981 and 1981 through 1984), the futures market on a week-to-week time frame is the dominant force in the price discovery process. All cash markets were satellites of the futures market. Over time, the authors found that there was a decline in the influence of the terminal markets. They found evidence that suggests a regionalization of markets around the country with market centers linked to dominant markets, but becoming increasingly separated from the national supply and demand situation.

**Purcell, Wayne D. and Michael A. Hudson.** "The Certificate System for Delivery in Live Cattle: Conceptual Issues and Measures of Performance." *The Journal of Futures Markets*. Vol. 6, No. 3. Fall 1986. pp. 461-475.

The conceptual framework within which the certificate system of delivery was developed and initiated is traced in some detail. Possible shortcomings of the certificate system are identified including the time required to complete the process and the restraints placed on the reclaim option for the short who is delivering. The authors hypothesize the barriers to a smoothly functioning delivery mechanism will lead to a wider and more variable basis. During the first five delivery periods after initiation of the new delivery mechanism, the basis was in fact significantly wider in some delivery areas. The variance of the basis, the important determinant of the success of hedging, was not significantly larger, however. In spite of the expressed concerns, the authors are positive regarding the certificate system because it eliminates redelivery of cattle and does encourage participation by long hedges.

**Hudson, Michael A. and Wayne D. Purcell.** "Price Discovery Processes in the Cattle Complex: An Investigation of Cash-Futures Price Interaction." Virginia Agricultural Experiment Station. Bulletin 85-12. Fall 1985.

This study analyzes the lead-lag relationships between live cattle futures prices, cash cattle prices, and carcass beef prices. The price data in this analysis went from January 1, 1977 through May 28, 1982 for live cattle futures contracts, Choice steer carcasses, yield grade 3, 600-700 lbs. from the National Provisioner and the midpoint of the high/low range from Amarillo, Texas Choice slaughter steers yield grade 3, 900-1,100 lbs. Causality regressions for all combinations of the three series were estimated using the Geweke procedure. Results of the analysis indicate live cattle futures and cash carcass beef prices are related instantaneously, and show a unidirectional flow from futures prices to carcass beef prices. A similar relationship exists with futures prices and cash steer prices. Of the three market sectors analyzed, the carcass market is the least important source of price discovery activity. All three markets interact and react with relative efficiency to changes in information. In the cash-futures subsector, the futures market is judged to be an important source of price discovery.



**Hayenga, Marvin L., Barbara S. Geisdale, Robert G. Kauffman, H. Russell Cross, and Lauren L. Christian. "A Carcass Merit Pricing System for the Pork Industry." *American Journal of Agricultural Economics*, Vol. 67, No. 2. May 1985. pp. 315-319.**

The results of an interdisciplinary study of pork carcass composition and value relationships are reported in this article. The authors develop a standardized objective carcass evaluation system for packers that will transmit to producer premiums and discounts for varying carcass merit. In this study, 185 carcasses were measured for characteristics that could be applicable to a grading or hedonic pricing system. A quadratic model specification was estimated that related carcass value to backfat thickness, carcass weight, and muscling score. The authors found that these three variables account for 79 percent of variation in carcass value. Using the results from the estimated model, a matrix of premiums and discounts was developed for carcasses of various merit. The authors conclude that use of a system such as the one they designed would enhance producer acceptance of carcass merit pricing and provide clearer signals where changes in production and marketing procedures are needed.

**Oellermann, Charles M. and Paul L. Farris. "Price Discovery in the Futures and Cash Markets for Live Beef Cattle." Presented Paper at the American Agricultural Economics Association Annual Meeting, Cornell University, August 7, 1984.**

This paper examined the relationship between changes in cash and futures prices for live beef cattle. The authors sought to identify which market leads the other in price discovery and if that relationship has changed as activity in the futures market has changed. Granger causality testing using ordinary least squares is employed. Data used were the daily closing price of the live cattle contract on the Chicago Mercantile Exchange and average cash price of 1,100 to 1,300 lb. Choice steers in Omaha. The data were divided into three subperiods of 1966-72, 1973-77 and 1978-82. The time span analyzed was two months prior to each delivery month for each contract per year. For nearly every time period analyzed, the futures price led the cash price. Information was incorporated by the cash market with a lag of one day after it affected the futures price. The importance of the futures market to price discovery is heightened by the decrease in instantaneous causality (intra-day flows of influence) observed in the 1978-82 subperiod compared to the previous two subperiods.

**Hudson, Michael A., Stephen R. Koontz and Wayne D. Purcell. "The Impact of Quarterly Hog and Pig Reports on Live Hog Futures Prices: An Event Study of Market Efficiency." AE-54 Department of Agricultural Economics, Virginia Tech, Blacksburg, VA. June 1984.**

The reaction of live hog futures prices to the quarterly release of USDA hog and pig reports is examined in this study. The flow of information to the markets is non-random because of the periodic release of USDA reports. Data used in the analysis covered the period December 1973 through September 1983 for forty hog and pig reports and the live hog futures price changes for 38 days surrounding the release of hog and pig reports for the nearby contract and one maturing in six months. The multi-step event study method of analysis was applied. The results indicate that futures markets adjust to new information from hog and pig reports rapidly. Indications of market inefficiency may in fact be the result of inadequate information and not inefficient markets. Large price adjustments after reports are required because of a divergence in the information set market participants are using and the true but unknown information set.

**Bessler, David A. and Jon A. Brandt. "Causality Tests in Livestock Markets." *American Journal of Agricultural Economics*. Vol. 64, No. 1. February 1982. pp. 140-144.**

Bessler and Brandt examine the lead-lag relationships between various variables suggested by economic theory for cattle and hog prices. Quarterly price and quantity data for U.S. cattle and hog markets from 1963 through 1979 are used in Granger regression tests. The results of the analysis suggest a strong one-way causal relationship exists running from sow farrowings to hog prices, from income to hog prices, from hog prices to hog slaughter, from cattle price to cattle on feed numbers, and from income to cattle prices. No strong one-way relationship was found to be running from changes in cattle on feed to cattle prices. The authors' findings suggest an instantaneous relationship between income and livestock prices. They suggest that their use of quarterly data may have prevented detection of actual lead-lag relationships of a duration shorter than one quarter.

**Ziemer, Rod F. and Fred C. White. "Disequilibrium Market Analysis: An Application to the U.S. Fed Beef Sector." *American Journal of Agricultural Economics*. Vol. 64, No. 1. February 1982. pp. 56-62.**

This paper examines the U.S. fed beef sector with the use of recently developed disequilibrium theory and estimation techniques. Disequilibrium in this study means market transactions occur at prices which do not clear the market, leaving market participants unable to trade desired quantities at the prevailing prices. The authors contend that four factors in the U.S. fed beef sector seem likely to lead to disequilibrium prices. Those four factors are;

1. non-uniform information,
2. concentration on both the buyer and seller side of the market,
3. lack of short-run production flexibility, and
4. government intervention.

A simple four equation model describing demand and supply is estimated based on quarterly observations from 1965 through 1979. The equilibrium model was estimated with two-stage least squares while the disequilibrium model was estimated using maximum likelihood techniques. Results indicate that the hypothesis of a permanent disequilibrium can be rejected for the U.S. beef sector, but price is not sufficiently flexible to insure continuous equilibrium. The authors suggest disequilibrium models can provide valuable information concerning the effect of institutionally induced price-quantity distortions.

**Faminow, M. D. "Analysis of the Lead-Lag Structure of Two Wholesale Beef Price Quotes Using Residual Cross-Correlation." *North Central Journal of Agricultural Economics*. Vol. 3, No. 2. July 1981. pp. 89-94.**

The objective of Faminow was to test for evidence of a lead-lag relationship between the Meat Sheet and the Yellow Sheet price quotes for meat. Given that these two price reporting services provide similar information collected in similar manners and used by market participants in similar uses, they should indicate an instantaneous relationship with nonsignificant residual cross-correlations for time lags. The residual cross-correlation technique was applied to daily closing price quotes for 700-800 pound yield grade 3 steer carcasses (Chicago base) for November 1, 1979 through November 3, 1980 providing 246 observations. The results indicate strong evidence of an instantaneous relationship between the two

price quote services. The results additionally provided weak evidence that the Meat Sheet lags the Yellow Sheet by one or two days. The two price quote services are thus closely but not perfectly related.

**Spreen, Thomas H. and J. Scott Shonkwiler.** "Causal Relationships in the Fed Cattle Market." *Southern Journal of Agricultural Economics*. Vol. 13, No. 1. July 1981. pp. 149-153.

Employing Granger's notion of causality, this study examines the extent to which feeder cattle prices and feed costs affect fed cattle prices. Spreen and Shonkwiler define the concept of causality used and use three computing methods (Granger, Sims and Haugh-Pierce) to test their causal hypotheses. Data used in this study were monthly Choice Omaha 900-1,100 pound steer prices, Kansas City 600-700 pound feeder steer prices, and a feed cost index of Chicago corn prices and Decatur soybean meal prices. The data were first differenced and covered the period January 1966 through December 1979, providing 168 observations. The causal relationships were examined over an eight month period, a time period during which almost all cattle on feed would be marketed. The results indicated that slaughter steer and feeder steer prices are determined simultaneously. Feed costs lead both feeder and fed steer prices. Increased feed costs increase fed steer and feeder steer prices in the first two months, then depress them through four months followed by an increase in the eighth month.

**Ward, Clement E.** "Short Period Pricing Models for Fed Cattle and Impacts of Wholesale Carcass Beef and Live Cattle Futures Market Prices." *Southern Journal of Agricultural Economics*. Vol. 13, No. 1. July 1981. pp. 125-132.

Ward examines impacts of wholesale carcass beef and live cattle futures market prices in short period pricing models on individual transaction prices for fed cattle. Ordinary least squares regression was used to analyze data from 26 commercial feedlots operated in Texas, Oklahoma, and Kansas and three markets for cattle feeders in Nebraska and Iowa. A total of 344 pens of cattle or 51,586 head marketed in July 1979 were analyzed. Wholesale carcass prices were collected twice daily from the National Provisioner and futures prices for the August live cattle contract were collected three times per day. Ward points out that modeling short period price (i.e., transaction prices) is very difficult. He did find that sex, weight, quality grade and yield grade for wholesale carcasses were significant in predicting the transaction price. Another variable that was fun-

damental to explaining transaction prices was the nearby futures price for the live cattle contract.

**Miller, Steven E. "Lead-Lag Relationships Between Pork Prices at the Retail, Wholesale, and Farm Levels." *Southern Journal of Agricultural Economics*. Vol. 12, No. 1. July, 1980. pp. 73-76.**

This study provides an empirical assessment of the lead-lag relationships of pork prices between the retail, wholesale and farm levels. The author uses the Granger causality approach with univariate residual cross-correlation analysis. Conceptually, the analysis is structured such that time ordered variable X is said to lead another time ordered variable Y if Y is better predicted with the use of historical X. The univariate residual cross-correlation statistical method was applied to weekly changes of USDA retail, wholesale and net farm pork values from January 1974 through June 1978. Farm level pork prices were found to lead wholesale prices by up to two-three weeks, and wholesale prices lead retail prices by up to two-three weeks.

**Miller Steven. "The Response of Futures Prices To New Market Information: The Case of Live Hogs." *Southern Journal of Agricultural Economics*. Vol. 11, No. 1. July 1979. pp. 67-70.**

The objective of this study was to examine the response of the hog futures market to the release of new market information from the USDA's Hog and Pigs Report. The author looked specifically at sow farrowing information. The analysis used data from 36 Hog and Pig Reports released from September 1970 through June 1978. Partial adjustment models were estimated using ordinary least squares and seemingly unrelated regressions. Results indicate futures markets respond in the expected direction to new market information, but the response is not instantaneous. For futures three to four months from delivery, one-half or more of the response to new information from the Hog and Pigs Report is completed in one day, for more distant contracts (six to seven months), one-half of the price response occurs within a week.

**Miller, Steven E.** "Univariate Residual Cross-Correlation Analysis: An Application to Beef Prices." *North Central Journal of Agricultural Economics*. Vol. 1, No. 2. July 1979. pp. 141-146.

This study discusses how univariate residual cross-correlation analysis is used with the Granger causality concept of lead-lag relationships. Miller provides a detailed description of the methodology of univariate residual cross-correlation analysis. This statistical technique was applied to first differences of weekly USDA retail, wholesale and net farm values for January 1974 through June 1978. As a whole, this analysis indicated that farm level price changes are reflected in wholesale level price changes within a week, and the wholesale price changes are reflected in retail price changes of beef within three weeks. The results imply that rapid price adjustments between farm, wholesale and retail levels are provided by the beef marketing system.

**Barksdale, Hiram C., Jimmy E. Hilliard and Mikael C. Ahlund.** "A Cross-Spectral Analysis of Beef Prices." *American Journal of Agricultural Economics*. Vol. 57, No. 2. May 1975. pp. 309-315.

The article examines the lead-lag relationship among prices at the feeder cattle, live cattle, wholesale and retail levels. Causality tests are used to confirm the direction of the influence identified by cross-spectral analysis. The data used were estimates of monthly prices at the feeder and live animal level and the wholesale and retail levels for a series of 288 observations beginning in January 1949 and ending with December 1972. The results of the analysis indicate that prices at the feeder, live animal and wholesale levels move together without a time lag as long as one month. Retail price lags the other three levels by a significant amount. In a quantity-price context, a lag of nine months is required for producers to accept price changes as a non-temporary phenomenon, divert animals, and feed them out.

## Efficiency of Livestock Futures Markets

**Colling, Phil L. and Scott H. Irwin.** "On The Reaction of Live Hog Futures Prices to Informational Components in Quarterly USDA Hog and Pig Reports." *Proceedings, NCR-134 Conference, Applied Commodity Price Analysis, Forecasting, and Market Risk Management.* April 20-21, 1989. pp. 17-35.

The authors report in this paper the testing of the market efficiency hypothesis by examining if live hog futures prices only react to unanticipated changes in hog inventories. In addition, they test if any predictable price pattern can be found beyond the first day of trading following the release of the .kp 8;Hog and Pigs report. The difference between market survey data of expected changes in breeding and market inventories produced by .kp 8;Futures World News, and the actual inventory data in the USDA .kp 8;Hog and Pig report is used as a proxy for unanticipated information. The survey data was tested for unbiasedness, efficiency, and superior forecast performance to examine if it had the suitable properties to use in testing the efficient market hypothesis. The sample period examined was September 1981 through June 1988. The results of the analysis found live hog futures prices incorporated the expected change prior to the release of the actual inventory data. The live hog futures price was found to react significantly in the expected direction to unanticipated information. The nearby futures contract was found to be the most responsive to unanticipated changes in market hog inventories, and prices of contracts at a time horizon of approximately one hog production cycle was most responsive to unanticipated changes in breeding inventory. A predictable price pattern was not evident from four of the five contract time horizons examined.

**Schroeder, Ted C. and Marvin L. Hayenga.** "Comparison of Selective Hedging and Option Strategies in Cattle Feedlot Risk Management." *The Journal of Futures Markets*, Vol. 8, No. 2. April 1988. pp. 141-156.

In this article, the results of a study of the distribution of returns generated from selective hedging strategies using either live cattle put options or futures contracts are reported. The hedging activity was triggered by either profit-margin targets or price-forecasting targets. The strategies were compared with each other by calculating a second degree stochastic dominance ranking. The marketing strategies were developed for an Iowa feedlot and were compared for cattle sold on a monthly basis for July 1978 through December 1985. In that options were not traded prior to

late 1984, the authors estimated option premiums using a modified Black-Scholes option pricing model. The dominant strategies were hedging with a \$4/cwt. profit margin and a put option strategy using a standard error adjusted forecast. The authors also analysed the alternative strategies on an annual basis. This annual analysis highlighted that options tend to be the most useful approach to hedging during periods of rapid cattle price increases. When price stabilizes, hedging strategies using options were less attractive because of the cost of option premiums.

**Elam, Emmett W. and Daniel Vaught.** "Risk and Return in Cattle and Hog Futures." *The Journal of Futures Markets*, Vol. 8, No. 1. February 1988. pp. 79-87.

This article addresses the apparent inconsistency between livestock futures being variable in price and thus risky, based on Keynes' definition, and the relatively low rates of return paid to speculators bearing this risk. Instead of using Keynes' measure of risk and price variability, the authors measured risk through the use capital asset pricing model (CAPM) approach. The CAPM approach measures risk in terms of systematic risk, the covariance between the return on an asset and the return on a market portfolio of all assets. Systematic risk was measured for the periods 1966-76 and 1975-85. The rate of return used for the market portfolio was derived by using a weighting of .90 to the sum of the monthly log-relative return for the S&P index plus the monthly dividend rate return and a weighting of .10 to the log-relative return for the Dow Jones Index of cash commodity prices. The authors found estimates of systematic risk of live cattle and hog futures to be sensitive to the market portfolio weighting of commodity returns. The estimates of systematic risk for cattle and hogs were -.03 and -.10 in the 1966 to 1976 period, and .20 and .24 for cattle and hogs respectively for the 1975 to 1985 period. The authors conclude that the low rate of return to speculators in cattle and hog futures is consistent with the low level of systematic risk for commodities.

**Garcia, Philip, Raymond M. Leuthold, T. Randall Fortenbery, and Gboroton F. Sarassaro.** "Pricing Efficiency in the Live Cattle Futures Market: Further Interpretation and Measurement." *American Journal of Agricultural Economics*, Vol. 70, No. 1. February 1988. pp. 162-169.

In this article, the authors report on a study that tested and evaluated the pricing efficiency of the live cattle futures market. Semi-strong form efficiency tests were conducted by using econometric, ARIMA, and compos-



its forecasting models, estimated on 1976-81 data, to forecast cattle prices in the 1982-85 period. The forecasts from these models were then compared to live cattle futures prices using the mean-square error framework to measure predictive accuracy. The results of this analysis suggested that live cattle futures were not incorporating all available public information. The authors developed simulated trading strategies based on the most accurate forecasting techniques to measure possible returns available from the identified inefficiencies in the futures market. This simulation process produced small, positive profits but with very large relative variances. The simulation of trading strategies did not account for the cost of building and updating the models. The results of this study demonstrated the mean-square error framework for evaluating futures market pricing efficiency is not a sufficiently rigorous criterion. The mean-square error framework was found to be a necessary condition for evidence of pricing inefficiencies in the live cattle futures market, but the sufficient condition (simulated profits) did not confirm the necessary condition.

**Hudson, Michael A., Raymond M. Leuthold, and Gboroton F. Sarassaro.** "Commodity Futures Price Changes: Recent Evidence for Wheat, Soybeans, and Live Cattle." *Journal of Futures Markets*, Vol. 7, No. 3. June 1987. pp. 282-301.

The distributions of futures price changes during the period January 1973 through December 1987 for wheat, soybeans, and live cattle are examined. Previous research had indicated the distribution of futures price changes were weighted to the midpoint and tails more heavily than would be expected with a normal distribution. The distribution of futures price changes has implications for market efficiency and for pricing formula for commodity option premiums. Tests for normality and independence were performed on the first differences of the natural logarithms of daily closing prices for each wheat, soybean, and live cattle contract maturing during the time period analyzed. Tests of normality were conducted at the .01 level of significance. The Kurtosis test rejected normality for 42 percent of live cattle contracts analyzed, but this dropped to 33 percent when the time period 1976-1982 was analyzed. The ratio of the range to the standard deviation test rejected normal distributions for 35 percent of the live cattle contracts. This test rejected 28 percent when the 1976-82 period was examined. Characteristic exponent tests found 30 percent of live cattle contracts had normal distributions and the remaining contracts had unbiased means through the validity of their variance as a measure of variability was in doubt. Bartlett tests for homogeneity of variance rejected the possibility of non-normal distributions being the result of heteroscedasticity. Independence was tested using turning-point tests and

phase-length tests. For turning-point tests, 23 percent of the live cattle contracts exhibited non-random behavior. The phase-length tests suggested 25 percent of the live cattle contracts had non-random behavior in price changes. The majority of the non-random behavior for both independent tests was found in the 1973-75 periods.

**Kenyon, David and John Clay.** "Analysis of Profit Margin Hedging Strategies for Hog Producers. *The Journal of Futures Markets*, Vol. 7, No. 2. April 1987. pp. 183-202.

This article reports on an examination of selective profit margin hedging strategies that determine if producers can raise average profits and reduce the variance of the profits. The authors developed a model to simulate production of hogs in six annual lots for a Southeastern Virginia, 150 sow, farrow-to-finish operation for 1975 through 1980. From the simulated production, daily expected profit margins were calculated. Selective hedging strategies were based on fixed margin strategies and variable margin strategies. Fixed margin strategies triggered hedges whenever the daily expected profit margins from the simulation model was above a fixed level. Variable margin strategies were based on a forecast of the cash margins and hedges were triggered whenever the daily expected profit margin exceeded the forecasted cash margin by a certain percent. The authors conducted a post-sample analysis of the hedging strategies for 13 lots of hogs marketed between December 1980 and December 1982. The analysis indicated that it was possible to increase average returns and reduce the variance of those returns through the use of selective hedging strategies. While the fixed margin strategies performed well, it was still possible to increase returns and reduce the variance of returns by using the variable margin strategies. The advantage provided from variable margin strategies stems from reducing the incidence of premature hedging associated with fixed margin strategies.

**Pluhar, Darwin M., Carl E. Shafer and Thomas L. Sporleder.** "The Systematic Downward Bias in Live Cattle Futures: A Further Evaluation." *The Journal of Futures Markets*. Vol. 5, No. 1. Spring 1985. pp. 11-20.

The study re-evaluates Helmuth's trading technique using unrevised USDA breakeven prices and additional basis adjustments over a longer time period. The analysis was conducted over the period July 1974 through December 1982 and encompassed Helmuth's test period of January 1978-February 1981. Statistically significant gross profits were generated using Helmuth's trading technique on unrevised data. Basis did

not appear to impact the results based on the use of alternative basis adjustments. The authors suggest that because this technique is based on economic rationale, it may be correlated with large trader activity and does not necessarily infer trader manipulation. The results suggest the effectiveness of the trading rule constitutes modest evidence of weak-form market inefficiencies in live cattle futures.

**Koppenhaver, G. D. "The Forward Pricing Efficiency of the Live Cattle Futures Market." *The Journal of Futures Markets*. Vol. 3, No. 3. Fall 1983. pp. 307-319.**

Koppenhaver contends that the futures market price does not have to be unbiased to fully reflect available information at a point in time. If a risk premium exists in the live cattle futures markets, then a bias will exist. Koppenhaver attempts to answer to what extent a risk premium does in fact exist in the live cattle futures price. If a risk premium does exist, is the live cattle futures market efficient in reflecting historical spot and futures price, and does the market reflect available public information? Live cattle futures contracts were analyzed from August 1969 through December 1982. Evidence of a risk premium in live cattle futures was found. With the existence of a risk premium confirmed, Koppenhaver rejects the use of the martingale model in favor of the submartingale model for testing market efficiency. The author concludes that use of the submartingale model in testing historic prices one, two, four and six months prior to maturity suggests the live cattle futures market is a weak-form efficient forward pricing mechanism. At one month prior to maturity, the author found the live cattle futures contract to be semi-strong form efficient.

**Kolb, Robert W. and Gerald D. Gay. "The Performance of Live Cattle Futures as Predictors of Subsequent Spot Prices." *The Journal of Futures Market*. Vol. 3, No. 1. Spring 1983. pp. 55-63.**

This article develops and applies methodology where prices are aggregated such that peculiarities of one time period may be offset against those of another in evaluating the performance of live cattle futures prices in the process of price discovery. The high volatility and strong price trends apparent in the live cattle futures can result in variable price performance depending on the time period selected for study. Kolb and Gay examine lag-link relatives for 38 live cattle contracts maturing between December 1976 and December 1980. Lag-link relatives are the natural log of the ratio of today's futures price to yesterday's futures price. Hotelling's T tests and regression tests over time were performed to test if futures prices

were accurate predictions of spot prices at maturity. The results confirm the hypothesis that futures prices are accurate predictors of subsequent spot prices. They found no reason to conclude that cattle futures fail to perform a price discovery function.

**Peterson Paul E. and Raymond M. Leuthold.** "Using Mechanical Trading Systems to Evaluate the Weak Form Efficiency of Futures Markets." *Southern Journal of Agricultural Economics*. Vol. 14, No. 1. July 1982. pp. 147-151.

Peterson and Leuthold develop a general framework to test for weak form efficiency in futures market using a mechanical trading system. Two types of filter rules are used for the final 10 months of trading for hog futures contracts between 1973 and 1977. The two filter rules are based on percentage change in price (one percent through ten percent) and a dollar change (\$.50 through \$5.00 in \$.50 increments). The weak form test is based on testing whether any strategy generates statistically significant profits. For all twenty of the tests, the mean gross profit exceeded zero and was statistically significant at the five percent level. The authors note that mechanical trading methods provide a method to detect non-random patterns that are simple and intuitively appealing, and they do not depend on repetitive patterns of price change.

**Helmuth, John W.** "A Report on the Systematic Downward Bias in Live Cattle Futures Prices." *The Journal of Futures Markets*. Vol. 1, No. 3. Fall 1981, pp. 347-358.

The efficiency of the live cattle futures market is tested by Helmuth with a technique developed for predicting movement in live cattle futures. Helmuth reports on a technique that predicted with 100 percent accuracy certain drops in live cattle futures for the period January 1978 through February 1981. When live cattle futures price covers USDA reported Corn Belt cattle feeding costs plus an interior Iowa-Southern Minnesota basis adjustment, the futures prices will drop. Helmuth suggests that the systematic downward bias in futures price is the result of a lack of commercial long hedgers in the live cattle markets. Commercial short hedgers are primarily commercial feedlots and meat packers all with similar per unit production cost. Therefore, when futures prices exceed production costs, short hedges are placed. In conclusion, Helmuth is concerned the live cattle futures market does not serve a valid economic purpose because it does not offer hedging opportunities to all producers and displays a systematic downward bias. He suggests that the live cattle futures pro-

vides limited hedging opportunities but only to those cattle feeders with the lowest per unit costs.

**Palme, Lennart A. and James Graham.** "The Systematic Downward Bias in Live Cattle Futures: An Evaluation." *The Journal of Futures Markets*. Vol. 1, No. 3. Fall 1981. pp. 359-366.

Palme and Graham evaluated and reported on some of the problems with Helmuth's research (Journal of Futures Markets, 1981) on live cattle futures markets. Their critique emphasizes four points:

1. Helmuth's finding that the market operates with a consistent, systematic, perfectly predictable downward bias is not supported by the data used in his (Helmuth's) study;
2. Helmuth's conclusion that hedging opportunities are provided to the low cost producer only is not valid. Data indicate the majority of cattle feeders had profitable hedging opportunities in 59 percent of the months analyzed;
3. Helmuth's trading signal technique was developed on data not available during the period the technique provided signals; and
4. Considering that traders have similar access to fundamental news and technical trading signals, it is surprising that Helmuth reported only 32 out of 1,027 larger traders had highly correlated trading patterns.

**Just, Richard E. and Gordon C. Rausser.** "Commodity Price Forecasting With Large Scale Econometric Models and the Futures Market." *American Journal of Agricultural Economics*. Vol. 63, No. 2. May 1981. pp. 197-208.

This paper compares and evaluates the price forecasting experience and accuracy of the commercial econometric model vendors. Live cattle and hogs are examined in addition to corn, wheat, the soybean complex, and cotton. Specifically, the study addresses the question of whether futures markets are more or less accurate than large scale econometric forecasts. The period examined was December 1976 through December 1978. Results of this analysis indicated that econometric models provided superior forecasts in comparison to the futures market for cattle in two, three and four-quarter time horizons. For hogs, the econometric models provide superior forecasts only in a four-quarter time horizon.

**Martin, Larry and Philip Garcia.** "The Price-Forecasting Performance of Futures Markets for Live Cattle and Hogs: A Disaggregated Analysis." *American Journal of Agricultural Economics*. Vol. 64, No. 2. May 1981. pp. 209-215.

Martin and Garcia attempt to answer the question "Do live cattle and hog futures markets function as price forecasting agencies?" Disaggregated analysis was used because these markets are characterized by seasonality, production and price cyclical behavior, and a significant change in volume and liquidity. The criterion used to test price forecasting performance was whether futures markets systematically over or under estimate the level of cash prices. The analysis also checked the ability of futures prices to explain movements in the cash price series. The analysis was conducted by regressing cash prices and a lagged futures prices series on a lagged cash price series running from October 1964 through December 1977. The results indicated that live cattle futures added little forecasting information over lagged cash prices, while hog futures performed the forecasting function well relative to cattle futures and lagged cash prices. Further analysis led the authors to suspect the performance of cattle and hog futures as a rational price formation agency because, in cases where forecasting performance was originally poor, it did not improve as the contract approached maturity.

**Giles, David E. and Barry A. Goss.** "Futures Prices as Forecasts of Commodity Spot Prices: Live Cattle and Wool." *The Australian Journal of Agricultural Economics*. Vol. 25, No. 1. April 1981. pp. 1-13.

This paper examines whether futures market perform a forward pricing function. Specifically, the performance of the futures market forward pricing function of a continuous and non-continuous inventory commodities were examined. The two commodities examined were Australian wool futures and Australian live beef cattle futures traded on the Sydney Futures Exchange. Data used in this study were monthly averages of daily price observations for wool from 1968-78 and for live cattle from 1975-79. A simple regression model of spot and futures prices was estimated using general instrumental variables estimators. Futures prices were found to be unbiased predictors of spot prices for wool and for live cattle with lags up to three months long. For live cattle, the results indicate that the futures market out performed spot prices as unbiased predictors of subsequent spot prices.

**Leuthold, Raymond M. and Peter A. Hartmann. "A Semi-Strong Form Evaluation of the Efficiency of the Hog Futures Market." *American Journal of Agricultural Economics*. Vol. 61, No. 3. August 1979. pp. 482-489.**

This study conducts a semi-strong form test of the efficiency of the live hog futures market. This test examines whether differences between the futures price in period  $t$  and the spot price that evolves in  $t + j$  after the receipt of new information is a random number. An econometric model was developed to forecast hog price reflecting available public information to act as a norm against which futures prices were compared. The econometric model was estimated first for 1964-70 then updated and re-estimated annually through 1976. Root mean squared errors and composite predictions were used to evaluate the two cash price predictors. Over the seven year period 1971-78, the futures market provided a smaller root mean square error and larger composite prediction errors. On a year by year basis, these results were not confirmed. The futures market for live hogs, the authors conclude, contains inaccuracies and cannot consistently be relied upon to accurately reflect subsequent spot prices. The authors concluded that the live hog futures market should not be considered efficient.

**Ward, Clement E. "Toward a Performance Evaluation of the Carcass Beef Market: Weak Form Test of the Efficient Markets Model." *Southern Journal of Agricultural Economics*, Vol. 12, No.1. July, 1980. pp. 95-101.**

A weak-form test of the efficiency of the carcass beef market is examined in this study. Tests of market efficiency were employed to identify if the thin market characteristics of this market has implications for the markets performance. Daily price data for 11 beef carcass classes from *The National Provisioner's Daily Market and News Service* for July 19, 1976 to November 16, 1979 were examined. Ward rejected the hypothesis that these prices are a random walk, and this result suggested a degree of market inefficiency was present. In addition, the price series was found to have a leptokurtic distribution. Ward suggests that the results indicate that the carcass beef market does not reflect all available information entering the market from the preceding market period, but there is not conclusive evidence to say the market is inefficient. The author suggests factors such as market psychology, predictability with which new information is disseminated in the market, and the market structure of buyers and sellers contribute to the serial dependence of the price series.

**Leuthold, Raymond M. and Peter A. Hartmann.** "An Evaluation of the Forward-Pricing Efficiency of Livestock Futures Markets." *North Central Journal of Agricultural Economics*. Vol. 3, No. 1. January 1981. pp. 71-80.

This study is an expansion of the hog market efficiency study by Leuthold and Hartmann (*American Journal of Agricultural Economics*, August 1979). The study was expanded to analyze live cattle, pork belly, and live hog futures. In addition, though using similar empirical techniques, the analysis was conducted with quarterly models rather than monthly models. Models were estimated over the 1964 through 1977 period with futures market forecasts and econometric forecasts examined for the 1971 through 1977 period. The analysis confirmed the author's 1979 findings for the hog market and indicated that the pork belly and live cattle markets also do not utilize all available information. The authors suggest, however, that growing use of the futures market may imply that information from the futures market is superior to alternative sources.

**Leuthold, Raymond M.** "The Price Performance on the Futures Market of a Nonstorable Commodity: Live Cattle". *American Journal of Agricultural Economics*. Vol. 56, No. 2. May 1974. pp. 271-279.

This paper examines the forward pricing function of live beef cattle futures. Specifically, Leuthold sought to examine the efficiency with which the forward pricing function of the live cattle contract was performed. Cattle and corn contracts were compared in terms of their forward pricing function. The first 36 live cattle contracts traded on the Chicago Mercantile Exchange were examined, contracts with maturity dates of April 1965 through February 1971. The results indicate that from about 15 to 36 weeks prior to delivery, the present cash price is a superior estimate of the future cash price compared to the futures contract price. Evidence suggests that over time, ability of the futures price to anticipate subsequent cash prices decreased. The author suggests that the live cattle future prices estimates subsequent spot prices as efficiently as corn futures prices, however.



## **Basis and Basis Risk**

**Elam, Emmett.** "Estimated Hedging Risk with Cash Settlement Feeder Cattle Futures." *The Western Journal of Agricultural Economics*, Vol. 13, No. 1. July 1988. pp. 45-52.

This article reports on research that examined whether hedging risk for feeder cattle is lower with a cash settled contract compared with a physical delivery contract. The author developed an equation that measures hedging risk based on how cash and futures prices move together. The hedging risk was estimated for feeder cattle using weekly average Arkansas auction market prices, weekly average CME feeder cattle futures prices, and a weekly Cattle Fax price. The period analyzed was 1977 to 1986. Because this was prior to cash settlement, the Cattle Fax price was used as a proxy for cash settled futures prices. The results of the analysis found that cash settlement reduced the hedging risk for feeder cattle above 600 pounds. Hedging risk was also lower for feeder cattle less than 600 lbs. with cash settlement when the cattle are marketed in the fall. The analysis examined weight ranges and specific months. The largest hedging risk reduction from cash settlement was 66.1 percent for steers weighing 600-700 lbs. hedged in the September contract. Hedging risk increased with cash settlement by 20-35 percent for steers hedged in the March, April, or May contract.

**Marsh, John M.** "Monthly Price Premiums and Discounts Between Steer Calves and Yearlings." *American Journal of Agricultural Economics*. Vol. 67, No. 2. May 1985. pp. 307-314.

This article examines the differences between the prices of 300-500 pound steer calves and the prices of 600-700 pound yearling steers on a monthly basis. Marsh uses a rational distributed lag econometric analysis framework to analyze the price differences. The variables impacting on the price differentials were cost of gain, seasonality, and the expected direction of slaughter cattle prices. Monthly USDA data for the period January 1972 through December 1982 were used for estimating the models. Results of the analysis indicate that the price of steer calves are impacted to a greater extent by changes in the cost of gain and by changes in slaughter cattle prices. This greater sensitivity of steer calf prices compared to yearlings was related to the extra time and weight gain and the resultant increased risk associated with raising steer calves to maturity.

**Garcia, Philip, Raymond M. Leuthold and Mohamed E. Sarhan.** "Basis Risk: Measurement and Analysis of Basis Fluctuation for Selected Live-stock Markets." *American Journal of Agricultural Economics*. Vol. 66, No. 4. November 1984. pp. 499-504.

The objective of this paper is to measure and analyze within-contract basis risk for cattle and hog futures markets. Basis risk is the unsystematic component of variance in basis over time. The systematic portion and the unsystematic portion of the variance of basis were separated using the variate difference approach. Daily bases were calculated for the December and June contracts for live hogs and live cattle beginning nine months from maturity from 1970 through 1979. With the unsystematic variance of basis isolated, regression analysis was used to identify variables influencing that component of basis variability. Results of this analysis indicates some seasonality in basis for hogs but little for cattle. Basis risk appears to increase when cash prices are high and when the general consumers price level is high. The authors did not find evidence that would suggest basis risk decreases as the contract approaches maturity.

**Garbade, Kenneth D. and William Silber.** "Cash Settlement of Futures Contracts: An Economic Analysis." *The Journal of Futures Markets*. Vol. 3, No. 4. Winter 1983. pp. 451-472.

This paper provides a historical discussion and review of cash settlement as a delivery mechanism for commodity futures contracts. A review of cash settlement practices is made and a discussion of specific factors that make cash settlement more or less attractive is included. The authors deal with the issue of how a cash settlement index should be constructed. They then provide a theoretical discussion of how cash settlement would function for futures contracts with heterogeneous grades. Garbade and Silber conclude that cash settlement can improve the futures markets by enhancing the risk transfer function of futures by providing closer convergence of futures and cash prices. The costs of delivery can be substantially reduced with cash settlement and new types of futures contracts are possible. They see cash settlement as bringing greater flexibility in contract design when heterogeneous commodity products are important. The caveat to cash settlement they provide is that the price index has to be a reliable indicator of the true commercial value of the commodity and must be free of potential manipulation.

**Buccola, Steven T. "Price Trends at Livestock Auctions." *American Journal of Agricultural Economics*. Vol. 64, No. 1. February 1982. pp. 63-69.**

Buccola examines the hypothesis that in English style auctions, price will decline over time or over lots as buyers become satiated. Buccola examined price trends at an individual Virginia auction market for fall yearling steers from 1958 through 1979. In his regression analysis, he included explanatory variables for lot size, weight, grade, breed and order in which the lot was sold during a day. The results confirm the hypothesis that price does decline during the course of a sale. The negative lot position effect was found to have become more pronounced over time as inflation increased and cattle price reached higher levels.

**Hogan, J. C. and M. C. Todd. "Empirical Tests of Spatial and Structural Effects on Cattle Auction Prices." *Australian Journal of Agricultural Economics*. Vol. 23, No. 3. December 1979. pp. 176-190.**

This article examines whether unexplained price differences occur between markets and what impact lot size, number of buyers, and size of auction market will have on cattle prices. These factors are examined in terms of the efficiency of livestock auction systems. Regression analysis was applied to data collected from Australian livestock markets collected over a 35 week period in 1977 and 1978. The authors found no conclusive evidence of price premiums in either county or metropolitan markets. The authors concluded that after allowing for transportation costs, weight, time and lot size, there were no differences in price levels at small or large auction centers. Prices at small centers were found to be more variable. A positive relationship was found between price per head and per unit lot size. No relationship was found between the number of buyers and price levels at either the large or small auction centers.

**Leuthold, Raymond M. "An Analysis of the Futures-Cash Price Basis for Live Beef Cattle." *North Central Journal of Agricultural Economics*. Vol. 1, No. 1. January 1979. pp. 47-52.**

This article develops and empirically tests a theoretical model to identify variables which affect the futures-cash basis for live cattle. Leuthold hypothesized that the basis provides insights about forthcoming changes in cash prices because basis reflects the movement in cash prices resulting from shifting supply and demand conditions. Demand was assumed constant in this study because time spans analyzed never exceed seven

months. Ordinary least squares was used to estimate basis equations for monthly data for 1965 through 1977. The models were not effective in explaining basis behavior for contracts close to maturity. Leuthold had somewhat greater success in modeling basis for distant futures contracts based on shifting supply. Some evidences of a seasonal behavior in basis was identified for live cattle. The coefficients of determination for basis models for two to seven months time horizons ranged from .78 to .90. Leuthold concludes that basis does reflect the expected change in cash prices from the current period until maturity of the futures contract resulting from shifts in supply.

**Menkhaus, Dale J. and W. Gordon Kearnl. "Influence of Breed, Sex, Lot Size and Weight on Feeder Cattle Prices." *Journal of Animal Science*. Vol. 42, No. 6. 1976. pp. 1389-1396.**

Menkhaus and Kearnl examine the influence of breed, sex, lot size and weight on feeder cattle prices. Data analyzed were 1,535 lots of cattle sold at special feeder sales in Wyoming during the months of September through December in 1973 and 1974. The yearly data were analyzed independently. Regression analysis was employed. Breed, lot size, sex and the month of the sale all influence prices paid. Weight was only significant in determining price in 1973. The results also indicated some preference among buyers for cross breeds rather than straight breeds.

## Futures Market Research Reviews

**Blank, Steven C.** "Research on Futures Markets: Issues, Approaches, and Empirical Findings." *Western Journal of Agricultural Economics*, Vol. 14, No. 1. July 1989. pp. 126-139.

Blank provides a brief assessment of the issues, methods, and results reported in recent research literature on agricultural futures and options. This review of literature deals with two broad areas. First, research on social value issues deal with pricing efficiency and resource allocation functions of futures markets. The social value issues were expanded to include price variance and risk levels in futures markets. Second, the firm-level issues deal with hedging, optimal hedge ratios, hedges in a portfolio framework, and marketing decision rules. This review, while highlighting issues in futures market research, also examined methods of evaluation employed by researchers. Since the introduction of *The Journal of Futures Markets*, scholarly research has dominated research on futures market issues. Blank notes there is a need to pay greater attention to the decision process of real-world firms. The shortcoming of academic research is that it tends to ignore the decision calculus of firms and thus miss significant attributes of futures market prices and the performance process. Blank's article is followed by a discussion by Allen Paul.

**Garcia, Philip, Michael A. Hudson, and Mark L. Waller.** "The Pricing Efficiency of Agricultural Futures Markets: An Analysis of Previous Research." *Southern Journal of Agricultural Economics*, Vol. 20, No. 1. July 1988. pp. 119-130.

This article reports on a comprehensive examination of past studies on the pricing efficiency of agricultural futures markets. The authors have not conducted solely a literature review but have conducted a statistical analysis of reported results so as to draw inferences about the pricing efficiency of agricultural futures markets. The authors analyzed 38 studies on futures market efficiency published between 1970 and 1985. The results of these studies were classified into categories based on the commodity analyzed, whether the study was a forecasting or non-forecasting study, if weak form or semi-strong form tests were applied, type of data used (monthly, weekly, or daily), and the time period analyzed. Logit models were employed in the analysis. Models were estimated for the data from forecasting and non-forecasting studies. The results indicate that when the futures market pricing efficiency is measured by the markets ability to forecast prices, the livestock commodities are more likely to

perform less well. The 1973 through 1979 period showed an increased tendency to find inefficiencies based on forecasting tests. The two results were suggested to be attributed to the non-storability of livestock commodities and the instability of agricultural markets during the 1973 through 1979 period, respectively. Similar, but less statistically significant results, were found from the analysis of non-forecasting studies. The authors found time horizons had an important impact on finding inefficiencies in forecasting studies. In addition, studies found more systematic components of price change when daily rather than monthly or weekly price changes were analyzed.

**Purcell, Wayne D. and Michael A. Hudson. "The Economic Roles and Implications of Trade in Livestock Futures." *Futures Markets: Regulatory Issues*. Anne E. Peck Ed. American Enterprise Institute for Public Policy Research. Washington, D.C. 1985. pp. 329-376.**

Purcell and Hudson do not set out to provide a review of literature of livestock futures trading. It is one of the by-products of their thorough discussion of the economic function of trade in livestock futures. The specific areas covered in this treatise are; identification of sources of controversy in livestock futures, the functions of risk transfer and price discovery, a description of empirical analysis of causal flows between live cattle futures and cash cattle and carcass beef prices; and finally an identification of areas where there are gaps in the body of knowledge on livestock futures trading.

**Kamara, Avraham. "Issues in Futures Markets: A Survey." *The Journal of Futures Markets*. Vol. 2, No. 3. Fall 1982. pp. 261-294.**

Kamara provides an extensive review of literature on futures markets. This review is not confined to livestock markets, but covers all futures markets. The specific areas Kamara deals with are; theory of hedging and speculation, basis in inventory and non-inventory commodities, behavior of futures prices, and the effect of futures trading on the cash markets and the informational role of futures markets. Kamara confined his review to literature published since 1970.

**Leuthold, Raymond M. and William G. Tomek. "Developments in The Livestock Futures Literature." Livestock Futures Research Symposium. R. M. Leuthold, P. Dixon Eds. Chicago Mercantile Exchange, Chicago. 1979. pp. 39-67.**

Leuthold and Tomek provide a thorough review of the literature on livestock futures. Concentration is on live cattle, live hogs, pork bellies, and feeder cattle. The subject areas covered by this review were; futures price behavior and the effect of futures on cash prices, the use of futures for livestock hedging, and who uses futures. Emphasis was placed on research published in professional journals and bulletins of universities and governmental agencies between 1965 and 1979.

## Structure/Concentration

**Ward, Clement E. and Timm J. Bliss.** *Forward Contracting of Fed Cattle: Extent, Benefits, Impacts, and Solutions.* Research Institute on Livestock Pricing, Research Bulletin 4-89, Agricultural Economics, Virginia Tech, Blacksburg, VA. December 1989. 49 pages.

The objective of this publication was to examine the extent of forward contracting of fed cattle in 1988. In addition, the authors explored cattle feeders' perception of the benefits and implications of forward contracting. Information on forward contracting was obtained through a mail survey of 3,700 cattle feeders in the 13 leading cattle feeding states. The authors reported a response of 503 questionnaires. Those feeders responding marketed over 750,000 head of cattle in 1988 by forward contracting. This represented slightly less than 13 percent of the cattle the respondents marketed that year. Respondents indicated that forward contracting might increase slightly to about 15 percent of marketings in 1990. Basis contracting was the most common type of forward contracting employed. Feeders indicated the primary benefit of forward contracting related to financing cattle and locking in a buyer. There was little support for the perception that forward contracting enhanced the sale price. Packers were perceived to seek forward contracted cattle to secure a supply of cattle for slaughter. Feeders indicated they felt buyer competition was adversely impacted by forward contracting. Regarding alternatives for government and industry policies on forward contracting, the two most preferred alternatives involved industry programs to monitor contract activity and voluntary reporting of contractual activity.

**Connor, John M.** *Concentration Issues in the U.S. Beef Subsector.* Northeastern Project-165, WP-16. September 1989. 55 pages.

This paper is part of the National Cattlemen's Association commissioned report on concentration/integration. The objective is to examine the various levels of the beef subsector to see if the change in concentration of ownership has altered the competitiveness of the beef subsector or any of the levels of the subsector. Beef is delineated as a distinct product by the consumer, and boxed beef should be considered as a separate industry from carcass beef. Further, the author suggests that fed cattle are bought in 15 distinct markets in the U.S. While cattle feeding is atomistic by any standard, the three largest box beefpackers account for 75 to 80 percent of the boxed-beef market. The three largest packers control approximately equal market share and are characterized as intense rivals. The



author notes that in beefpacking, there is not a pattern of price leadership by any one packer on the selling side of the beef market. Four grocery chains were purchasing 55 to 60 percent of their boxed beef from the three large packers, and the packers thus face countervailing power on the selling side. The author provides the caveat that if beefpacker concentration rises above the current historically high levels, this countervailing power by retailers will count for little. At present, product differentiation and the associated higher margins to the processor are limited by government and retailer assurances of quality to the consumer. The author suggests the direction that the concentration issues take is dependent upon the approach taken by the government policy in this area.

**Azzam, Azzeddine and Emilio Pagoulatos.** *Testing for Oligopoly and Oligopsony Power.* Northeastern-165 Project, WP-15. September 1989. 19 pages.

The authors propose an empirical model for testing market power in both the input and output markets. The model is applied to the U.S. meatpacking industry. Through the use of a production function that allows all inputs to be used in variable proportions and the derivation of market-specific conjectural elasticities, it is possible to develop a model that does not impose assumptions of identical market power on the input and output sides of the market. The authors apply this model to annual aggregate data from the U.S. meatpacking industry from 1959 through 1983. Using iterative non-linear three-stage least squares, the model was estimated. The results of the estimation indicate that there are statistically significant but differing degrees of market power in the input and output markets. The results suggest that the U.S. meatpacking industry has greater market power in the input (livestock procurement) market than exists in the output (meat) market.

**Koontz, Stephen R., Michael A. Hudson, and Philip Garcia.** "Oligoposony Power, Meatpacker Conduct, and Price Dynamics: A Preliminary Investigation of Live Cattle Markets." *Proceedings NCR-134 Conference, Applied Commodity Price Analysis, Forecasting and Market Risk Management.* April 20-21, 1989. pp. 318-330.

The authors report on preliminary results of the use of a model of market conduct which uses non-cooperative game theory to explain the interaction among meatpackers in the procurement of live cattle. The analysis used price quotes from direct feedlot-to-meatpacker sales of 900 to 1,100 pound steers. The regions examined were Iowa and Southern Minnesota,

Eastern Nebraska, Western Kansas, and Texas. The data employed were daily prices from the USDA's weekly LS-214 publication. The theoretic model requires a stable industry over time. Two time periods were examined -- June 1980-June 1982, and June 1984-June 1986. The results of the analysis (though preliminary prior to the model being fully tested) suggest evidence of increasing cooperative pricing across meatpackers. This was most evident in Iowa and Eastern Nebraska during both of the periods examined and in Texas during the latter period. Western Kansas, which has the most major meatpackers competing for the available supply of cattle, did not provide evidence of cooperative behavior consistent with the game theory model. The results suggest that the non-cooperative game theory model may be useful in examining the existence of short-run market power by meatpackers in the procurement of live cattle.

**Ward, Clement E. *Meatpacking Competition and Pricing*. Research Institute on Livestock Pricing, Agricultural Economics, Virginia Tech, Blacksburg, VA. 1988. 222 pages.**

Prompted by dramatic changes in the U.S. meatpacking industry during the early and mid-1980s, this book attempts to consolidate much of what is known concerning competition and pricing in the meatpacking industry. The structure-conduct-performance approach is taken in the analysis. The author has made a special effort to restrict technical, economic, and statistical components of research and reviewed literature to appendices, thus leaving the chapters understandable to the non-economist. Ward reports evidence of economies of size are clearly present in beefpacking and porkpacking, and suggests that in addition to individual plant economies, multi-plant or inter-plant economies also exist. The price process is reviewed relating procurement practices of meatpackers and the wholesaling of meat products. The reporting of the pricing process is followed by a review of theories -- oligopoly and oligopsony pricing -- in evaluating market conduct in the industry. Performance measures are discussed in the context of technical and pricing efficiency. Industry profitability in the meatpacking industry is also reviewed. In summary, Ward suggests meatpacking has trended towards oligopolistic structures. An up-to-date and comprehensive report of current research by the author and other researchers is provided. It sheds light on the current industry organization and suggests that greater resources need to be devoted to monitoring the meatpacking industry and greater effort needs to be made to collect data relevant to competition and pricing in a changed industry. The recommendations are offered to improve the assessment of industry performance and enhance confidence in the competitiveness of the pricing process.

**Hogeland, Julie A. "Market Access in an Era of Structural Change in the Livestock Industry." USDA, ACS. September 1988. 53 pages.**

This publication reports the results of a survey of livestock (cattle, hogs, and sheep) producers in 14 states by the Agricultural Cooperative Service, USDA and the American Farm Bureau Federation in late 1987 and early 1988. The survey sought to solicit producers' perceptions of current market access and competition compared with their recollections of the situation in the early 1980s. Of the almost 7,500 producers surveyed, over 1,700 responded. The majority of respondents were feedlot producers or hog producers. The largest group of those feedlot producers responding marketed less than 50 head annually and 65 percent of respondents marketed less than 500 annually. The largest group of pork producers responding marketed between 1,000 and 9,999 head annually and less than 2 percent of the respondents marketed more than 10,000 head annually. The survey found a marked increase in the number of producers receiving only one or two bids on their livestock in the 1987-88 period in comparison to 1982. Consistent with this finding, the paper reports producers were finding a reduction in market outlets available for their livestock in the 1987-88 period compared to 1982. The survey results suggest producers are marketing the majority of livestock to just one packer, and that between the early 1980s and the mid to late 1980s, this phenomenon has been increasing. The survey solicited producers' attitudes regarding packers' systems of paying on grade and yield basis. The majority of producers felt grade and yield selling increased returns. When asked about what should be done about the problem of decreasing numbers of livestock buyers, the producers three dominant responses were:

1. form group marketing programs,
2. limit or prohibit mergers, and
3. do nothing.

Overall, this publication integrates administrative data concerning change in market structure with the results of producers' perceptions of how they are being affected by that changing structure.

**Connor, John M. and Frederick E. Geithman.** "Mergers in the Food Industries: Trends, Motives, and Policies." *Agribusiness, An International Journal*, Vol. 4, No. 4. July 1988. pp. 331-346.

This article focuses on the factors that affect merger activity and the motives behind current merger activity with an emphasis on merger activity in the food industry. Rather than an empirical analysis, the authors present data to highlight historical trends in mergers and survey the literature on motives for mergers and the impact of mergers. The review of trends in merger activity tends to suggest that activity has been higher in the food and tobacco manufacturing than all U.S. manufacturing and mining industries. The authors review of motives rests upon two primary explanations for mergers. The first is based on neoclassical economics and the assumption of profit maximization. Firms merge because of the expectations that profits from the merged firm will exceed those had the firms remained independent. The higher profits can be expected from economies of scale and scope or from more competent management. Additionally, mergers can be a form of diversification and thus lower the variance of profits. The second motive or explanation for a merger is a non-neoclassical based explanation. The theory suggests managers use mergers because they seek growth or "empire building". This latter explanation suggests merger activity stems from management and is not driven by profit maximization. The evidence of merger motivation indicates that, based on both an industrial organization and a financial analysis perspective, profit maximization fails to be the primary motivation for mergers. The authors suggest that merger activity results in a loss of public information, and thus creates barriers to entry. They conclude by suggesting that industrial conglomeration appears to have no market driven limits nor countervailing economic forces.

**Mullen, John D., Michael K. Wohlgenant, and Ronald E. Farris.** "Input Substitution and the Distribution of Surplus Gains from Lower U.S. Beef-Processing Costs." *American Journal of Agricultural Economics*, Vol. 70, No. 2. May 1988. pp. 245-254.

This study examines the impact of input substitution on producers and consumers. The authors develop a two-input (cattle and marketing) and a two-output (beef and by products) industry model. The technical change examined is the innovation of tray-ready beef. This technology represents an innovation over boxed beef. This new technology can cause a shift in the inputs demanded and, thus, depending on the substitution between inputs, benefits of technical change will accrue differently. The authors provide a detailed model of the industry that defines how the

benefits will be distributed. A representative year in the early 1980s was simulated for the analysis. Average prices for 1984 and average quantity and share data for the 1980 through 1984 period were used. The analysis provides ranges for short run gains from the tray-ready innovation of 51 to 72 percent going to cattle producers, with beef consumers gaining 27 to 48 percent of the benefits. Consumers of beef byproducts gain about 1 percent of the benefits. Their analysis suggests that cattle prices would be 1.8 to 2.3 percent higher from this innovation, and retail beef prices would decline .6 to .9 percent. The new technology was considered as a downward shift in the supply of marketing inputs. This could be considered alternatively as a cost-saving technology. The authors note that by appropriately weighting the estimated shift in supply of marketing inputs, the equivalent results as biased technology change will be found. This study indicates cost information can be used in place of unknown shifts in demand for inputs resulting from technical change.

**MacDonald, James M. "The Microdynamics of Structural Change: Patterns of Mergers and Diversification Activity Among Food Manufacturers." *Agribusiness, An International Journal*, Vol. 4, No. 2. March 1988. pp. 143-156.**

This study makes use of the U.S. Small Business Administrations U.S. Establishment Microdata file to analyze the growth and decline (microdynamics) over time of individual businesses. The analysis was conducted for 1976 and 1982. The analysis of individual firms over time is unique, and differs from the traditional approach of comparing industry averages over time. The objective of the analysis was to trace what industries and regions firms entered, left, expanded, or contracted. The analysis focused on 294 food manufacturing firms that operated in four sectors -- agriculture, food, tobacco, and other manufacturing services. The results indicate that diversified producers are the likely source of new entry in capital intensive industries, and that new entry is mostly by acquisition. During the period studied, food manufacturers grew rapidly with more than half the growth coming from diversification. Divestitures were also extremely important during this period. The diversification that food manufacturing firms made tended to be towards related industries in food service or agriculture. The author suggests that stable industry averages conceal an enormous amount of offsetting diversification and divestiture activity for food manufacturing firms during the period analyzed.

**Schroeter, John R.** "Estimating the Degree of Market Power in the Beefpacking Industry." *The Review of Economics and Statistics*. Vol. 70, No. 1. February 1988. pp. 158-162.

This effort adapts the framework for estimating the degree of monopolistic performance in a market to one that allows assessment of monopolistic and monopsonistic performance. The technique is then applied to annual data on the U.S. beefpacking for the years 1951-1983. A system of equations was estimated in quasi-first differences using full information maximum likelihood to allow the estimation of conjectural elasticities. These conjectural elasticities were used in conjunction with Lerner's index and an index based on the difference between marginal net revenue product and an index of factor prices to identify monopoly and monopsony price distortions. The results found clear evidence that an assumption of beefpackers being price takers is inappropriate. The magnitudes of price distortion resulting from the monopoly-monopsony structure were estimated to be relatively small, 3 percent from the monopoly side and 1 percent from the monopsony side, for the latter years in the 1951-83 period. The author notes the size of price distortions did not increase with the increase in packer concentration between 1977 and 1983.

**Kilmer, Richard L. and Walter J. Armbruster.** *Economic Efficiency in Agricultural and Food Marketings*. Iowa State Press, Ames, IA. 1987. 314 pages.

Dealing with agriculture and food marketing rather than specifically livestock, this book provides a summary of the current knowledge of economic analysis in this area. The intent is broad as opposed to dealing with specific topics or subsectors of the industry. Implications of economic efficiency for firms and public policy are considered. Conceptual and methodological models for economic efficiency and possible gaps in these models are identified. Chapters are provided on areas relevant to this bibliography such as: Economies of Scale, Efficiency and Market Information, Issues of Grading and Quality, and Futures Market and Intertemporal Pricing. The approach taken is to present a paper and then "discussion" by eminent scholars in these areas.

**Ward, Clement E.** "Productivity-Concentration Relationship in the U.S. Meatpacking Industry. *Southern Journal of Agricultural Economics*, Vol. 19, No. 2. December 1987. pp. 217-222.

This article extends work that suggests the presence of welfare gains to society from productivity improvements related to higher concentration levels in the food manufacturing industry to the meatpacking industry. Ward examines changes in productivity and concentration in the U.S. meatpacking industry for a 25-year period, 1958-1982. The data used were derived from Census of Manufacturers and from Packers and Stockyards Administration, USDA. The results of the analysis indicate that neither total factor productivity nor labor productivity was related significantly positively or negatively to concentration in meatpacking. These results tend to conflict with results from analysis of food manufacturing as a whole and with studies showing economies of size in meatpacking. The author suggests that this conflict in results stems from inter-industry analyses masking relationships due to aggregation biases. In addition, this analysis was conducted for meatpacking in general and not for specific species and, thus, may not capture all the possible increases in productivity that may result from economies of scale and size.

**Skaggs, Jimmy M.** *Prime Cut Livestock Raising and Meatpacking in the United States, 1607-1983*. Texas A&M University Press, College Station, TX. 1986. 263 pages.

Skaggs provides an historical review of the development of the red meat industry in the United States from colonial times up through the early 1980s. This study deals not just with the meatpacking, but with the development of different methods of livestock production, the movement to ranching in the western United States, and the subsequent retrenching and restrictions of the vast range ranchers. The role of government and labor unions in this industry are reviewed. This study provides a brief, but comprehensive, history of the major developments in the red meat industry in the United States. In addition, a very useful and complete bibliography is included. The author closes with the following caveat after reviewing the development of the early 1980s: "How much further history will go in repeating itself remains to be seen".

**Hayenga, Marvin L., Ronald Deiter, and Cristobal Montoya.** "Price Impacts Associated With the Closing of Hog Slaughter Plants." *North Central Journal of Agricultural Economics*, Vol. 8, No. 2. July 1986. pp. 237-242.

The purpose of this article was to examine the behavior of market prices for hogs in local markets after a slaughtering plant closed. The authors examined six plant closings and two subsequent plant-reopenings between 1978 and 1983. Each case that was examined was related to a plant in a major hog producing region. Weekly prices were examined six months prior to the closing of the plant and six months after the closing of the plant. Specific price differences were examined between the local market and high-volume control markets that would not have been affected by the plant closing. Ordinary least squares techniques were used to estimate models relating the price differences with binary variables for time intervals following the closing of a plant. The results indicate that there were no sustained statistically significant impacts on hog prices associated with a single slaughtering plant closing. This suggests that market arbitrage by the remaining participants was quick and effective.

**Quail, Gwen, Bruce Marion, Frederick Geithman, and Jeffrey Marquardt.** *The Impact of Packer Buyer Concentration on Live Cattle Prices.* North Central Project 117, Working Paper 89. May 1986. 87 pages.

This publication presents an empirical examination of buyer concentration in the fed cattle market. The authors provide a thorough discussion of changes of historical importance in the meatpacking and cattle feeding industry. The methods of cattle procurement of cattle and marketing of beef are described. A detailed review of the literature on meatpacker concentration and fed cattle pricing is presented. The hypothesis tested is that fed cattle prices are lower in markets where packers exercise monopsony power than they are in competitively structured markets. The authors analyze prices for USDA Choice steers weighing 900 to 1,100 pounds in 13 regions of the U.S. The time period analyzed was confined primarily to the decade of the 1970s. Concentration ratios and a Herfindahl index were used to measure market structure. The results suggest that buyer power, as measured by concentration ratios, depressed fed cattle prices in certain regions of the U.S. during the 1970s. The results imply that had the four-firm concentration ratio not risen from 48 percent in 1971 to 67 percent in 1980, cattle prices would have been \$.19 per hundredweight higher in 1980. This resulted in an estimated loss to feedlot operators of \$45.2 million in 1980. With the Herfindahl index, the 1980 loss to feedlot operators was estimated at \$50 million. The authors suggest that in regions with little competitive buying



a need exists to examine alternatives such as electronic marketing to broaden market opportunities and reduce the level of buyer concentration.

**Marion, Bruce W.** *The Organization and Performance of the U.S. Food System.* NC-117 Committee, Lexington Books, Lexington, PA. 1985. 533 pages.

The examination of the organization and performance of the U.S. food system is approached by focusing on agricultural production sectors, the food manufacturer, and the food distribution system. This book is a comprehensive summary of work carried out by the North Central Regional Committee 117 Project. In addition to dealing with the organization and performance of components of the U.S. food chain, the legal environment (antitrust) affecting the system is presented. The implications of the structure of the food system for performance and public policy encompass the conclusions of this book.

**Connor, John M, Richard T. Rogers, Bruce W. Marion, and Willard F. Mueller.** *The Food Manufacturing Industries: Structure, Strategies, Performance, and Policies,* Lexington Books, Lexington, MA. 1985. 474 pages.

This book is a comprehensive study of the U.S. food manufacturing industrial organization. The authors make use of the U.S. Standard Industrial Classification (SIC) to examine what is broadly identified as the "food and tobacco manufacturing" industries between 1947 and 1982. The authors rely upon the industrial-organization paradigm, supply and demand conditions determining market structure, and market conduct effecting economic performance in their analyses. Basic data on seller concentration, product differentiation, and conditions of entry and exit are provided for the classical dimensions of market structure. This is followed by an examination of patterns of conduct in the food industries. Cattle procurement by meatpackers is examined as an example of conduct in procurement markets. A review of quantitative market structure-performance research is presented. The authors examine how various public policies affect competition in the food industry and provide suggestions for improving public policy.

**Hayenga, Marvin, V. James Rhodes, Jon A. Brandt, and Ronald E. Deiter.** *The U.S. Pork Sector: Changing Structure and Organization.* Iowa State University Press, Ames, IA. 1985. 172 pages.

This book provides the results of a coordinated review of the economic interrelationships in the entire pork sector from breeding stock to the final consumer. A description of the organizational structure at each stage of the pork sector is presented, along with a description of the evolutionary pattern of the stage. At each stage, the pricing and coordination system is reviewed. The authors employed the structure-conduct-performance paradigm in the review. This paradigm provided a method of relating the structure and overall vertical coordination present in the sector. In addition, the approach provides insights into location of markets at each stage of the sector. The results of this analysis suggest that the pork slaughter/processing industry was weakly oligopolistic in the early 1980s. It was apparent from this research that economies of size are present in large, modern plants killing between 2 and 4 million head per year. The marketing of live hogs directly to packers has expanded because of operational efficiency. The authors offer the caveat that this transition to direct marketing presents problems for the price discovery process and the dissemination of price information. The authors found that wholesaling of pork has been done primarily through negotiations of formula price arrangements based on the Yellow Sheet market report of the National Provisioner.

**Nelson, Kenneth E.** *Issues and Developments in the U.S. Meatpacking Industry.* USDA-ERS Staff Report No. AGES850502, Washington, D.C. August 1985. 39 pages.

This report provides a brief review of the dominant issue of concern in the mid-1980s in the meatpacking industry. Concentration was the dominate issue, with further concern relating to the make-up of ownership of the industry and to implications for the pricing process. Of interest is the review of how the beef and pork sectors got to their present (1985) structure. Nelson has brought together an excellent summary of data for identifying trends in the meatpacking industry relative to other food manufacturing sectors. Having provided a synopsis of the industry, Nelson identifies the implications of the changing industry structure and trends. He suggests the future of the industry will be shaped by a broadening of meatpacking to both red and white meats and by further advances in technology in processing and distribution of meat. Specialization of processing and augmentation of markets were also expected to continue.

**Duewer, Lawrence A.** *Costs of Retail Beef-Handling Systems: A Modeling Approach.* USDA-ERS, Technical Bulletin No. 1704. June 1985. 55 pages.

This bulletin reports on a study of alternative methods of purchasing and handling beef. The study simulated 10 alternative methods of handling beef at the retail level. These 10 alternatives ranged from carcasses delivered by the packer to retail stores, to packer prepared tray-ready beef distributed through retailers' warehouses. The costs associated with the various alternatives were based on economic engineering and capital budgeting technique cost estimates (including labor costs) and are based on 1984 costs. The results of the analysis confirm that when additional factors such as shelf life and consumer aversion to frozen meat are considered, boxed beef distributed through warehouses to retail stores is the most attractive. Tray-ready beef is attractive, but given the then-present premiums associated with tray-ready beef, its attractiveness was limited in this simulation. The author notes that if tray-ready beef follows the path of boxed beef, competition will drive these initial premiums down. Labor was the significant cost in these systems and the primary differences in the systems was due to the location of labor intensive operations. Meatcutting at a warehouse or packing plant had advantages because it allowed for specialization of labor tasks. In the conclusion, there is some estimate of the impact of moving to the more efficient systems in reducing beef prices to consumers and stimulating additional movement of beef. The author suggests that savings to consumers could be in the order of \$1.4 billion and over 450 million additional pounds of beef would be demanded annually.

**Walsh, Margaret.** *The Rise of the Midwestern Meat Packing Industry.* The University of Kentucky Press, Lexington, KY. 1982. 182 pages.

This study is an examination of regional development of the porkpacking industry. This book is primarily concerned with the development of the industry during the mid to late 19th century. Walsh provides an in-depth treatment of the porkpacking industry and how the development of this industry was an integral part of the industrialization of the region. The book is also important as a resource tool. Fifty percent of the book is devoted to a bibliography and to the identification of reference material on the pork processing industry.

**Miller, Stephen E.** "The Structural Stability of Concentration-Performance Relationship in Food Manufacturing." *Southern Journal of Agricultural Economics*, Vol. 14, No. 2. December 1982. pp. 43-49.

This article evaluates tests for the structural stability of concentration-profit relationships. Food manufacturing firms were used in the analysis. The author analyzes alternative statistical techniques for identifying structural stability in concentration-profit relationships. The concentration-profit relationship is used as a proxy for concentration-performance relationships in the analysis of industry structure. If and where the concentration-profit relationship is discontinuous, it can be used as an indicator of possible anti-competitive behavior of firms in the market. The author notes that in reviewing previous research on concentration-profit relationships, he found that samples were selected so as to include the areas where structure changed. This type of analysis invalidates the usual tests of statistical significance. The author proposes two alternative methods to identify structural change in concentration-profit relationships. First, plot the cumulative sum of recursive residuals against an order variable (CUSUM) and the related plot of cumulative sum of squared recursive residuals against an order variable. Second, a log-likelihood ratio test should be employed. Empirical testing of these methods was conducted using 1950 data on 97 food manufacturing firms from the Federal Trade Commission. This data set was used because of the limited availability of data sets that provide profitability data on individual firms. The results confirmed the applicability of the alternative testing procedures. The results emphasize the importance of relating critical concentration ratios for specific industries to possible performance impacts.

**Gisser, Micha.** "Welfare Implications of Oligopoly in U.S. Food Manufacturing." U.S. Food Manufacturing, *American Journal of Agricultural Economics*, Vol. 64, No. 4. November 1982. pp. 616-624.

This article addresses the issue of concentration on productivity in the U.S. food manufacturing sector. The author tests whether productivity and concentration are linked and whether concentration can be considered a source of welfare gain offsetting social losses associated with oligopolistic power. The analysis was conducted using a Census of Manufacturers data set augmented with an annual survey of manufacturers data for the 1963-72 period. The analysis found an unambiguous relationship between changes in concentration levels and an increase in factor productivity in the U.S. food manufacturing. Through the use of a price-leadership model, Gisser found that increases in total factor pro-

ductivity, which is linked to concentration, roughly offsets the loss to consumer welfare associated with oligopolistic behavior of food manufacturers. The author concludes by suggesting that antitrust activity to restructure the industry might deprive society of benefits from the economies of size that accrue from concentration.

**Ball, Eldon V. and Robert G. Chambers.** "An Economic Analysis of Technology in the Meat Products Industry." *American Journal of Agricultural Economics*, Vol. 64, No. 4. November 1982. pp. 699-709.

The authors seek to examine the extent and direction of factor substitution, economies of scale, and the ways in which technical change occurs in the meat products industry. This is done by estimating a nonhomothetic cost function for the meat products industry using annual time series data for the 1954-76 period. A discussion of the dual relationship between cost functions and production functions is provided as the theoretical base for using the nonhomothetic cost function approach. The empirical results indicate that all input pairs (capital, labor, energy, materials, and structure) act as if they were substitutes. The scale elasticities indicate that the meat products industry is characterized by increasing returns to scale. This phenomenon is particularly evident in the period starting around 1972. The authors suggest that their results indicate that the meat products industry was not near its long-run competitive equilibrium (in 1976). They speculate that contraction in the industry has contributed to the disequilibrium that existed. Technical change that had taken place was found to be labor saving and material using. Scale economies were being led by higher labor prices, and higher labor prices contributed to greater cost reduction from technological advances.

**Ward, Clement E.** "Relationship Between Fed Cattle, Market Shares, and Prices Paid by Beefpackers in Localized Markets." *Western Journal of Agricultural Economics*, Vol. 7, No. 1. July 1982. pp. 79-86.

This publication reports empirical evidence on prices paid for fed cattle among beefpackers and on the relationship between market share and prices paid in relatively localized markets. The author sought to test the hypothesis that, in relatively small geographic markets, larger beefpackers pay significantly lower prices for fed cattle than their smaller competitors. Data for the analysis came from sampling 26 commercial feedlots in Texas, Oklahoma, Kansas, and three marketing agents in Nebraska and Iowa. The data collected covered 344 pens of cattle or 51,586 head sold during the month of July 1979. The market shares for the largest buyer

ranged from 25 to 48.9 percent, and for the four largest buyers market share ranged from 69.6 to 100 percent in the areas studied. The results of the analysis found no significant evidence to support the hypothesis that larger beefpackers pay lower prices. The empirical analysis considered the effects of quality differences and time of purchases on the prices paid for the cattle. Ward suggests that price differences were related to access and ability to use information on demand and supply, plant localities and transportation costs, and slaughtering and processing costs.

**Yeager, Mary.** *Competition and Regulations: The Development of Oligopoly in the Meat Packing Industry.* JAI Press Inc. Greenwich, CT. 1981. 296 pages.

This book provides an historical treatment of the meatpacking industry from the start of the 19th century up to the early 20th century. This period encompassed the development of meatpacking firms into national firms using new technology with assembly line processes. The period of study also contains the initial appearance of an oligopolistic market structure in meatpacking. In this study, Yeager avoids the biases of earlier studies that were aggressively either pro or anti-packer. The approach taken is to view the economy in terms of a dual economy where a center economy exists with large firms and a peripheral economy with many small firms. The meatpacking industry is examined in an effort to understand why oligopoly structure comes to characterized industries of the center economy and to answer the question on whether the oligopoly structure precedes or follows the monopoly structure. Yeager examines the role of markets and technology in the development of the industry structure and competitive environment. The role of government and the influence it exerts are examined. The consequences of the industry structure and government action for the American economy are considered.

**Menkhaus, Dale J., James S. St. Clair, and A. Zahed Ahmaddaud.** "The Effects of Industry Structure on Price: A Case in the Beef Industry." *Western Journal of Agricultural Economics*, Vol. 6, No. 2. December 1981. pp. 147-153.

The purpose of this article was to estimate the influence of concentration and other structural variables on the price of slaughter cattle. The authors contend that oligopsony behavior will be evident in prices rather than in profits because profits are influenced by both buying and selling behavior, and the objective is to specifically examine concentration and buying behavior. Models for 1972 and 1977 were estimated for deflated

average price of Choice 900-1,100 lb. slaughter steers at specific state markets. The estimated models were cross sectional rather than time series models. The empirical results suggest that concentration is negatively related to the prices paid for fed cattle. The size and significance of this negative relationship increased during the two periods examined. The authors reported that in the 1977 model, there was an indication that larger feedlots were able to exert some countervailing power on price pressure from higher buyer concentration levels.

**Reimund, Donn A., J. Rod Martin, and Charles V. Moore. "Structural Change in Agriculture: The Experience for Broilers, Fed Cattle, and Processing Vegetables." National Economics and Statistics Service, USDA. Technical Bulletin No. 1648. April 1981. 73 pages.**

This bulletin provides a descriptive treatment of the historical events that have contributed to structural change in agriculture, specifically dealing with structural change in the fed cattle sector. The authors suggest that factors outside the sector itself combine to pressure the sector to change. These factors can include:

1. new technology, biology, mechanics, or organization,
2. shifting market forces or demand changes, and
3. government policies.

Given these factors, structural change takes place following the paradigm of innovators adopting new technology, production shifting to areas more amenable to the new methods, output rapidly increasing, and finally new institutions emerging to allow the subsector to better manage new risks. For the fed cattle sector, the authors present a scenario of technology, developed during World War II in aluminum and plastic, allowed for increased mechanization in feed handling, animal waste disposal, farming, and irrigation of dry land. Combined with the development of hybrid sorghum production, such technology enabled the Southern Plains to become a major feed grain production area with large feedlots. The combination of government feed grain policies providing stable feed prices, tax advantages providing capital to commercial feedlot operators, and cattle futures markets providing a risk transfer mechanism enhanced the structural shift in the fed cattle sector. This shift also produced a change in the cattle slaughter sector resulting in moves to modern, single-floor facilities close to the cattle production areas. The structural change in cattle slaughter involved the closing of smaller facilities close to urban centers because of efficiencies gained in transporting carcasses rather than live animals.

**Maltop, John R. and John W. Helmuth. "Relationship Between Structure and Performance in the Steer and Heifer Slaughter Industry." Committee on Small Business, U.S. House of Representatives, Staff Report, September 1980. 55 pages.**

Based on early indication of rising four-firm concentration ratios in the beefpacking industry, this study examines whether there has been an impact on pricing performance resulting from change in market structure. The authors provide an interesting discussion of what is the relevant market to examine. The focus of the study is narrowed to firms slaughtering heifers and steers in 23 principal cattle-producing states. Concentration ratios developed on a state-by-state basis by the USDA were combined with individual state total slaughter of steers and heifers to produce a weighted concentration as a measure of market power for the combined 23 states. The hypothesis of this study is that increased concentration in beefpacking will lead to larger average firm sizes, higher carcass and boxed-beef prices, higher live cattle and retail prices, and expanded carcass-retail price spreads. The empirical tests were performed by estimating reduced form-inverted demand functions relating price to quantity demand and cost factors at the retail and carcass level using quarterly data for the period 1969-1978. The results of the empirical analysis suggest that when using the weighted average of market share for the 23 largest steer and heifer producing states, there was evidence that concentration levels influenced prices for fresh beef. The authors contend that the concentration levels present in 1980 provide price enhancing power to the largest slaughtering firms and that an oligopoly-oligopsony market structure better characterizes the carcass and boxed-beef markets than would a model of workable competition.

**Paul, Allen B. "Some Basic Problems of Research into Competition in Agricultural Markets." *American Journal of Agricultural Economics*, Vol. 61, No. 1. February 1979. pp. 170-177.**

The basic premise of this article is that to analyze competition in agricultural markets, there exists a need to broaden partial equilibrium theory and a related need to develop a theory of disequilibrium. Introduction of time as an explicit dimension of price needs to be made. Time is as important a dimension as is form and place. The three dimensions Paul notes -- time, form, and place -- tend to change over time. Indirect markets exist in specialized services that transfer commodities in form, place, and time. Paul contends that there is a need for the tantonement process and to evaluate it based on how well it makes prices consistent with



quantities demanded and supplied in comparison with other methods. The use of average price levels or profit rates as indicators of market performance may not tell us much about market deficiencies when the markets are in disequilibrium. In defining market boundaries, Paul suggests defining the length of run of the market and the place and form of the product. Paul contends that institutional innovations are just as important as technical innovations. Institutions often change so as to mitigate economic hazards. Activities firms undertake can be related to the failures of the market. Failures of the firm can result in greater reliance on markets. Paul suggests that if deficiencies in the market exists, there is a question of whether they can be remedied and whether large firms are a help or a hindrance to the process.



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