MONOPSONY POWER IN AN INDUSTRY IN DISEQUILIBRIUM: BEEF PACKING, 1971-1986

by

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Introduction

Between 1977 and 1987, the U.S. beef packing industry was restructured at a pace unprecedented in large American industries. Whereas in 1977, 32 percent of U.S. steers and heifers were slaughtered by the largest four beef packers, by 1987 that share had more than doubled to 68 percent. We estimate that slightly over half of this increase can be traced to mergers and acquisitions while the remainder was due to internal growth (Marion and Kim 1990).

This sharp run-up in industry concentration has triggered widespread concern among farmers, state and federal legislators and university scholars concerning the effectiveness of competition in beef packing[1]. However, the sharp increase in concentration largely occurred during a period when the performance effects of industry concentration were increasingly being challenged in the academic community and when enforcement by the antitrust agencies reflected a growing agnosticism toward concentration as a measure of market power. Several articles questioned the conventional wisdom concerning the concentration-market power relationship (Demsetz 1974; Peltzman 1977; Brozen 1970; Mancke 1974; Fisher and McGowan 1983).

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[1] The following reports and/or investigations are indicative of this concern:

- Hearings on Mergers and Concentration: The Food Industries before the Subcommittee on Monopolies and Commercial Law of the House Committee on the Judiciary, May 1988.
- Publication of Meatpacking Competition and Pricing (Clement Ward) by VPI Research Institute on Livestock Pricing, July 1988.
- Hearings on Concentration in Meat Packing Industry before House Committee on Agriculture, Iowa State Legislature, December 1988.
- Report by National Cattlemen's association (NCA) Beef Industry Concentration/Investigation Task Force, October 1989.
- Report on Competitive Issues in the Beef Sector by team of economists commissioned by NCA (D. Gale Johnson, October 1989).
- Report on Competition and the Livestock Market by task force of Center for Rural Affairs, April 1990.

Many of the differences among economists revolve around the influence of market concentration and the height, source, and durability of entry barriers. Concentration-price studies are particularly relevant to the debate since they avoid most of the limitations of concentration-profit studies and provide implicit evidence of the presence or absence of entry barriers. This has been generally recognized by authors of the "new" as well as "old" industrial organization economics (Scherer 1980; Geithman, Marvel, and Weiss 1981; Clarke, Davies, and Waterson 1984). Sustained supra-competitive prices can only be realized in markets with significant entry barriers.

This article reports the empirical results of a concentration-price analysis of live cattle procurement markets. It not only contributes to the widespread interest in meat packer concentration and the broader debate about the influence of market concentration, but also focuses on a seldom researched aspect of it: the impact of buyer concentration on prices received by atomistic sellers.

Previous Research on Monopsony (Oligopsony) Power

Several previous studies have examined the presence of monopsony power in livestock procurement markets. Menkhaus, St. Clair and Ahmaddaud related state level packer concentration to fed cattle prices in 12 states for 1972 and 15 states for 1977. A significant negative relationship was found in both years. The four control variables included in their models were similar to variables used in the present analysis. Ward examined the price effects of the number of buyers bidding on pens of cattle (1981) and lambs (1984). In both studies, the number of bidders had a significant positive relationship to transaction price. The higher prices resulting from more bidders may have

been due to increased competition between buyers and/or improved seller information.

Schroeter used the conjectural variation approach to estimate monopoly and monopsony price distortions in beef packing for the period 1951-1983.[2] His results indicate that price distortions remained roughly constant during 1970-1983, averaging about 3 percent due to monopoly power and 1 percent due to monopsony power. In the present study, we assumed that the output market in the beef packing industry was competitive and make no attempt to measure monopoly price distortions. Our estimate of monopsony price distortions is similar in magnitude to Schroeter's. However, we do not use his results as corroborating our results (or vice versa) because of a number of questionable assumptions his model required.

Specifically, Schroeter assumed that fed cattle were purchased in a national market and that the Omaha terminal market price was an accurate reflection of fed cattle prices. It was also assumed that each firm held the same conjectures about its competitors, both on the buying side and the output side, and that all firms' marginal costs were identical at equilibrium. Finally, his model assumed a constant elasticity of demand over the period 1951-1983. It is likely that none of these assumptions hold.[3] As a consequence, we believe the similarity between our and Schroeters's estimates of monopsony price distortions to be largely accidental and not a convergence of sound yet different estimating procedures. The key issue is specifying a model that reflects the competitive forces in actual markets. Where several

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[2] This approach represents the so called "New I.O." and was largely popularized by studies from Applebaum (1982) and Cowling and Waterson (1976).

[3] See Ward (1982), Williams (Committee on Small Business, Part IV, 1979), Buse (1989), and Quail et al. (1986).

regional geographic procurement markets exist, a national market model is simply inappropriate.

Just and Chern (1980) examined the supply and demand relationships for tomatoes surrounding the adoption of the mechanical tomato harvester in the mid-1960s. Formal theory is presented to demonstrate the implied effect of the cost saving technological change on demand and supply elasticities given competitive and noncompetitive markets. Their results, both econometrically and logically, supported the conclusion that observed price-output results after the adoption of the harvester were consistent with a dominant-firm, price-leadership oligopsony.

Monopsony power has also been studied in manufacturing-retailing markets. Most studies have examined markets in which oligopolistic sellers are selling to buying markets that range from atomistic to concentrated oligopsony. The hypothesis tested is that increased buyer concentration reduces the ability of oligopolistic sellers to charge supra-competitive prices. Lustgarten, Brooks, Clevenger and Campbell, and La France all found empirical support for this hypothesis--that is, a negative relationship between buyer concentration and seller price-cost margins. None of these studies examined markets in which atomistic sellers face oligopsonistic buyers, the situation that exists in most agricultural producer-first handler markets.

U.S. Meat Packing Industry: From Oligopoly to Competition to Oligopoly

The U.S. meat packing industry prior to the 1970s was frequently identified as an industry that had become more competitive over time. Product differentiation was generally minor except for processed and cured pork products. In part because of USDA grades, brands of fresh beef have never

been successfully established. National concentration of meat packing, which was high at the turn of the century and at the time of the 1920 Consent Decree, experienced a long decline until about 1970.

Until the 1960s, the "old line packers" (Swift, Armour, Wilson, Morrell) continued to lead the industry with older multi-species (e.g., hogs, beef and lambs) plants. In the 1960s, specialized beef slaughtering plants operated by "new breed" packers began to penetrate the industry by locating new plants in the Western Corn Belt and High Plains where cattle feeding was increasing. Today, plants tend to be specialized by species (hog or beef) and may also be specialized by function (slaughter or processing). Although pork and beef compete to some extent for consumers' meat dollars, they are in separate product markets at earlier stages in the production-marketing system. Beef packers also tend to specialize in either fed beef, which is sold as steaks, roasts and other cuts through supermarkets and restaurants, or in cows and bulls which are boned out and used in ground beef and a variety of processed meat products. Cows and bulls are mostly cull dairy animals. Plants slaughtering the latter animals generally are located in the major dairy states. Fed beef slaughterers are concentrated in the major cattle feeding states and do not compete directly with cow and bull slaughterers.

Geographic Markets for Fed Cattle

The geographic markets for fed cattle are difficult to define. There is no clear consensus. Menkhaus et al used states as geographic markets. Ward (1982) used parts of states that were roughly 100 to 150 miles in diameter. In a recent study, Ward (1990) studied four "markets" that averaged 100 miles in width by 180 miles in length.

Williamson et al examined two regions (High Plains and Iowa-Nebraska) to determine if they were in different geographic markets (U.S. Dept. of Agric. 1982). On the basis of product flow, the regions were judged to be separate markets. Based upon tests for price interdependence, Williamson concluded the two regions were in the same geographic market. We have questioned elsewhere the validity of Williamson's price interdependence methodology (Quail et al, p. 13-16).

More recently, Margaret Schultz (1988) studied the relevant procurement markets for beef slaughtering firms. Based upon a price correlation analysis for 10 different areas, Schultz found that all areas were statistically related. She concluded that Texas-Oklahoma and the Midwest are in a single "relevant market." The weight given the Williamson and Schultz conclusions depends upon the credence given the price correlation method for defining markets.

Stigler and Sherwin (1985) provide one of the most widely cited discussions of the price correlation approach to defining geographic markets. However, Scheffman and Spiller (1985) contend that the price correlation approach may be useful in defining economic markets but will often fail to define antitrust markets; the latter are defined as geographic areas in which market power can be exercised--the "markets" proposed by the Justice Department Merger Guidelines of 1984. The classical definition of markets, which Scheffman and Spiller label "economic markets," originated with Marshall (1920), who defined a market as an area where "prices of the same goods tend to equality with due allowance for transportation costs" (p. 324). Thus, an "economic market" is an area in which prices are linked to one another. However, Scheffman and Spiller argue that economic markets and antitrust

markets are not synonomous. Antitrust markets may be larger but are frequently significantly smaller than the corresponding economic markets. They propose estimating the elasticity of residual demand facing groups of producers. Using the approach in the Department of Justice merger guidelines, a geographic area would be gradually expanded until the residual demand of contiguous areas is low in elasticity.

Scheffman and Spiller's approach is attractive conceptually but empirically difficult. Thus, we have not attempted to measure the residual demand of different areas. However, their distinction between economic and antitrust markets may be useful. Geographic markets for live cattle that are defined by price correlations may ignore the ability to exercise market power. Prices in two areas may be highly correlated because of common cost or demand factors or the use of formula pricing, not because there is interdependence between the two areas.

In the analysis reported here, we use 13 of the geographic markets defined by Willard Williams. (Committee on Small Business, Part 4, 1979). Williams's definitions were based upon feedlot and packing plant locations and estimates of fed cattle to plant trade flows. Among other sources, Williams interviewed Market News reporters in different areas. Our own telephone interviews with Market News reporters indicate that Williams's regions have remained relatively accurate descriptions of trade flows throughout the 1970s and the 1980s, with the possible exception of Region 9 (E. Kansas and W. Missouri) and Region 1 (Washington, Oregon and Idaho).

The size of our geographic markets are generally larger than those used by Ward in his 1982 and 1990 studies, slightly larger than Menkhaus et al, but smaller than the market definitions suggested by Williamson et al and Schultz.

The latter two studies employ the price correlation approach to market definition, which frequently overstates the size of geographic markets. We have tested the price correlation approach for defining geographic markets in food retailing, gasoline retailing, fed cattle and eggs. Our experience to-date is that the price correlation approach frequently gives false positive results (says two areas are in the same market when in fact they are not). The approach rarely seems to give false negative results (says two areas are not in the same market when in fact they are).

Thus, although we cannot prove that our geographic markets are correct, we have found no persuasive evidence that they are wrong. There is clear evidence that live cattle are sold in relatively local markets. For example, Ward (1982) found that 80 percent of fed cattle in 1979 were slaughtered within 150 miles of the feedlot because of perishability and the high cost of transporting live animals. As packers have made greater use of just-in-time inventory methods, the geographic scope of markets may have declined over the last decade.

Although we believe our geographic markets are better than the alternatives proposed, it is also worth noting that errors in correctly identifying product or geographic markets tend to bias concentration-performance results toward zero. Since our concentration data were available only for the regions specified, we were not able to compare our results with the statistical results using other geographic markets.

Structure of National and Regional Markets

National concentration of fed steer and heifer slaughter has risen substantially since the end of the 1960s, increasing from 27.4 percent for the largest four packers in 1972 to 32.3 percent in 1978. Four-firm concentration

(CR4) then rose sharply over the following eight years to 60 percent by 1986 (Helmuth, and unpublished Packers and Stockyards Administration data). As a result of several large mergers, CR4 increased to about 68 percent in 1987.

The regional procurement markets used in our analysis are shown in Figure 1. The 13 regions accounted for roughly 87 percent of fed cattle marketed in the U.S. in 1988.[4] Concentration of fed steer and heifer slaughter in regional procurement markets is 20 to 25 points higher than national concentration. The four leading packers in each region, on average, slaughtered 53 percent of the region's steers and heifers in 1971 and 58 percent by 1978. By 1986, average regional CR_4 had mushroomed to 85% (special tabulation by Packers and Stockyards Administration).[5] Mergers in 1987 and 1988 along with plant closures by smaller packers increased regional concentration to 87 percent by 1988.

Fed cattle are slaughtered by two types of plants: 1) plants that slaughter only and sell carcass beef; and 2) integrated slaughtering-fabricating plants that both slaughter and process carcasses into boxed beef. Integrated plants are largely owned by the top 20 beef packing companies.

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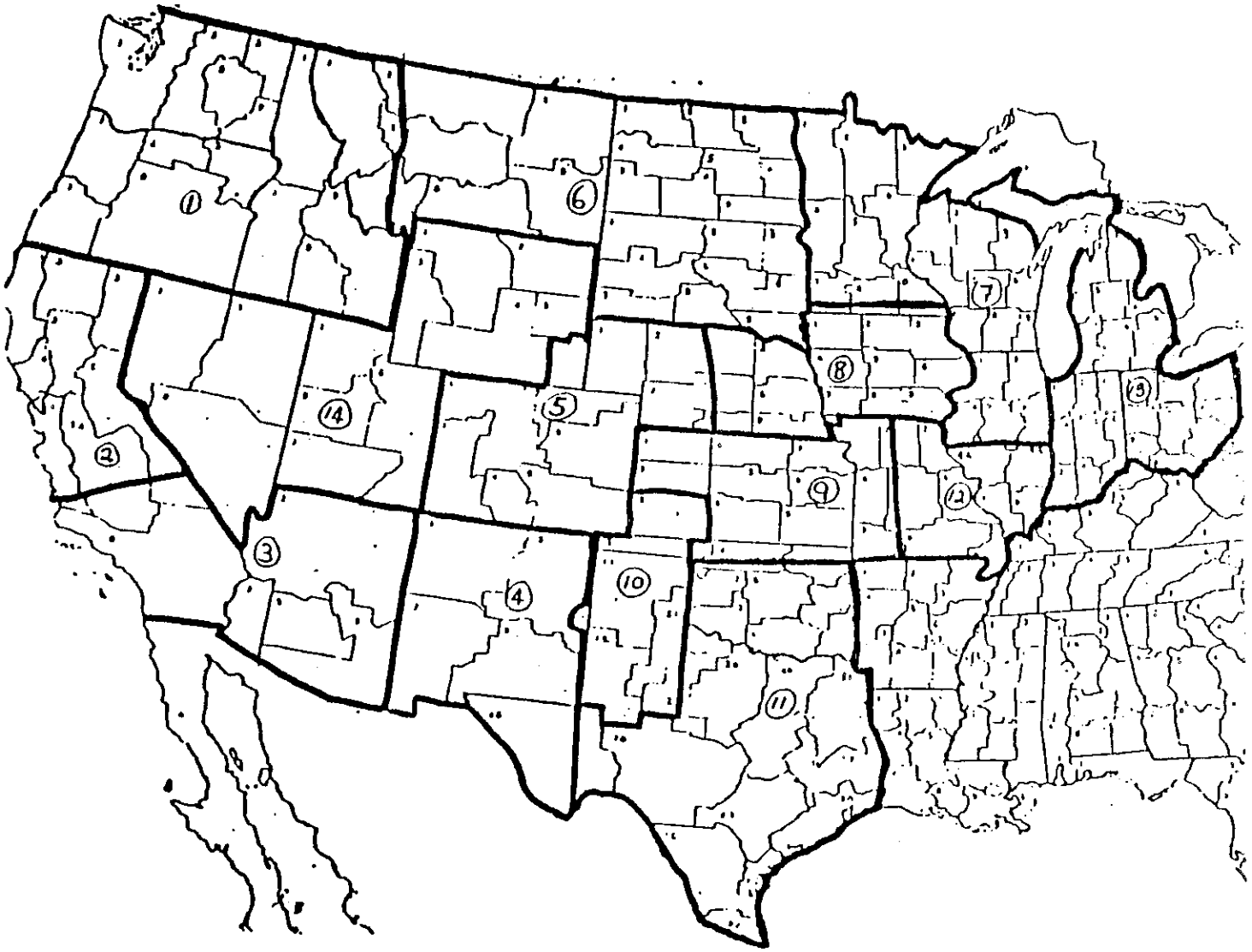
[4] Regional boundaries are reported in Quail et al, Appendix A (1986). Region 14 is not included on our analysis due to lack of data.

[5] At the end of 1986, Region 8 had a CR4 of 77 percent. Only three other small regions had lower CR4s in 1986 (Regions 3, 11, and 13). Region 8 is dominated by IBP, Inc. with four of their smaller plants located there. A 1989 announcement of a new IBP plant in Lexington, Nebraska suggests that a realignment of regions will be necessary in future studies. Lexington, Nebraska sits just west of our region 8 boundary in Dawson County. Dawson County is a major fed cattle producing county in Nebraska.

Figure 1. Geographic Boundaries of 14 Regional Fed Cattle Markets



Boxed beef has been one of the major developments in beef packing in the last 20 years. Whereas in the 1960s, nearly all beef left the packer as forequarters or hindquarters, most of it is now sold as boxed beef. Boxed beef accounted for 31 percent of fed steers and heifers slaughtered in 1972, 48 percent in 1979 and 80 percent in 1987 (Johnson, et al, p.80). The national four-firm concentration ratio for boxed beef sales was 80 percent in 1987, somewhat higher than the CR_4 for steer and heifer slaughter.

Boxed and carcass beef tend to be shipped from the major production/processing areas to the centers of population -- particularly the eastern U.S.. The approximate continental dividing line for beef shipments to the east or west is a line from Texas to Colorado (Faminow and Sarhan; Clary, Dietrich, and Farris).

Economies of scale exist in both beef slaughtering and processing. Until recently it was thought that a specialized slaughtering plant that killed 250 thousand head per year using two shifts would realize most of the scale economies available (about 1 percent of the U.S. fed cattle slaughter). Economies of scale appear to be greater in boxed beef processing (Cothern et al.). A recent study by Sersland (see Ward 1988) suggests that scale economies may exist well beyond the 250,000 head per year capacity identified by Cothern et al. The Sersland study was not a technical analysis of scale economies but rather relied on interviews with plant managers on average costs. Most of the new combination beef slaughtering-processing plants have a slaughtering capacity of 500,000 to 1 million head per year.

Entry barriers into beef packing are relatively high because of the capital cost of a new integrated plant, the difficulty of penetrating the boxed beef market, and the displacement effect in procurement markets of a

minimum efficient scale plant.[6] By 1986-88, a plant killing 250,000 head per year would require at least 25 percent of the total supply in eight of the 13 regions studied. If an MES plant requires 500,000 head, only six regions had room for two or more MES plants. Obviously, plants with design capacities of a million head per year plan either to capture a significant percentage of available supply and/or attract additional fed cattle to its procurement area.

Feedlot-packer negotiations nearly always occur at the feedlot. Whereas 39 percent of cattle were sold directly by feedlots to packers in 1960, this had increased to 80.2 percent by 1987; 91 percent of steers and heifers were sold direct in 1987 (USDA 1986). Cattle feeders are dependent on packer buyers coming to the feedlot, inspecting their cattle, and making an offer.

Because cattle are purchased live and the exact market value is known only after they are slaughtered, the value of a specific lot of cattle must be estimated by both buyer and seller. A small percentage of cattle are sold on a grade and yield basis. Due to transportation costs, shrinkage in cattle weight and uncertainties concerning the price they will receive in other regions, unsold cattle are rarely shipped to packers outside their region. They may be shipped to terminal markets, although these markets have declined to a tiny share of U.S. steers and heifers.

During the period of our analysis fed cattle marketed from commercial feedlots (greater than 1,000 head capacity) grew substantially. In 1971 commercial feedlots accounted for 62% of fed cattle marketings in the 13 major

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[6] The new slaughtering plant to be built by IBP in Lexington, Neb. (1.04 million head capacity) will be at a projected cost of 70 million dollars. There already exists an excess slaughter capacity of about 8 percent in the industry. (Food Institute Report, 1/7/89).

cattle feeding states.[7] In 1988, commercial feedlots accounted for 84% of fed cattle marketings. These same 13 states accounted for 85% and 87% of total fed cattle during 1971 and 1988.

Disequilibrium of Late 1970s and 1980s

Most economic theory deals with conditions of equilibrium. This is true with the theory of markets. But markets are not always in equilibrium. And past research has shown that market power may have less (or no) effect during disequilibrium conditions, such as during a period of rapid inflation (Weiss 1974).

Rapid inflation was only one of the disequilibrating forces affecting the beef packing industry during certain parts of 1971-1986, the period examined in this study. The growing inflation of the 1970s had a particularly strong impact on older beef packers because most of these firms were on the "master contract" with the union. The master contract not only called for higher wage rates than those paid by "new breed" packers, but also contained a COLA (cost of living adjustment) clause that escalated wages during inflationary periods. By the latter half of the 1970s, older beef packers found themselves more and more out of line with the wages paid by IBP. Many of the older packers either withdrew from beef packing, re-negotiated labor contracts, or changed plant ownership. During 1976-80, there was a considerable scramble to "get competitive" with the new breed packers.

The dramatic increase in inflation and interest rates during the late 1970s and early 1980s also placed pressure on undercapitalized packers. Well

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[7] From 1971-1981 the USDA reported fed cattle marketings by feedlot capacities for 23 states. In 1982 the number of states reported by the USDA dropped to 13.

financed packers were able to weather these conditions and to take advantage of the weakened financial condition of other packers.

A structural change in demand may also have occurred around 1979-80 (Buse 1989). While the evidence on this is mixed, a shift in demand to become more elastic may trigger greater price rivalry by packers, thereby reducing the market power of packers, ceteris paribus.

The entrenchment of boxed beef also occurred during the late 1970s and early 1980s. Only 31 percent of beef was boxed in 1972; by 1980, this had increased to 51 percent and to 70 percent by 1984. As this occurred, packers without boxing facilities increasingly found the market for beef carcasses was withering away. Packers with boxed beef plant were able to pick up market shares.

Figure 2 indicates the change in national CR_4 in the slaughter of fed steers and heifers during 1972-1987. While most of the concentration increase that occurred during 1986 and 1987 was due to mergers, much of the increase during 1977-1984 was from internal growth.

Figure 3 portrays live cattle and wholesale beef prices between 1977 and 1980. From 1971 to 1975, beef prices trended up. They then dipped during 1976-77, the liquidation phase of the cattle cycle. Prices then spurted to a new level by 1979 and 1980 from which they trended downward through 1986. Cattle prices ranged from 61 to 68 percent of wholesale beef prices during 1971-86 (Appendix Table A).

Economic Analysis

In many respects, Figures 2 and 3 capture the dynamics of the beef industry during 1971-1987: rapid increases in concentration and volatile prices. The substantial disequilibrium in meat packing during the late 1970s

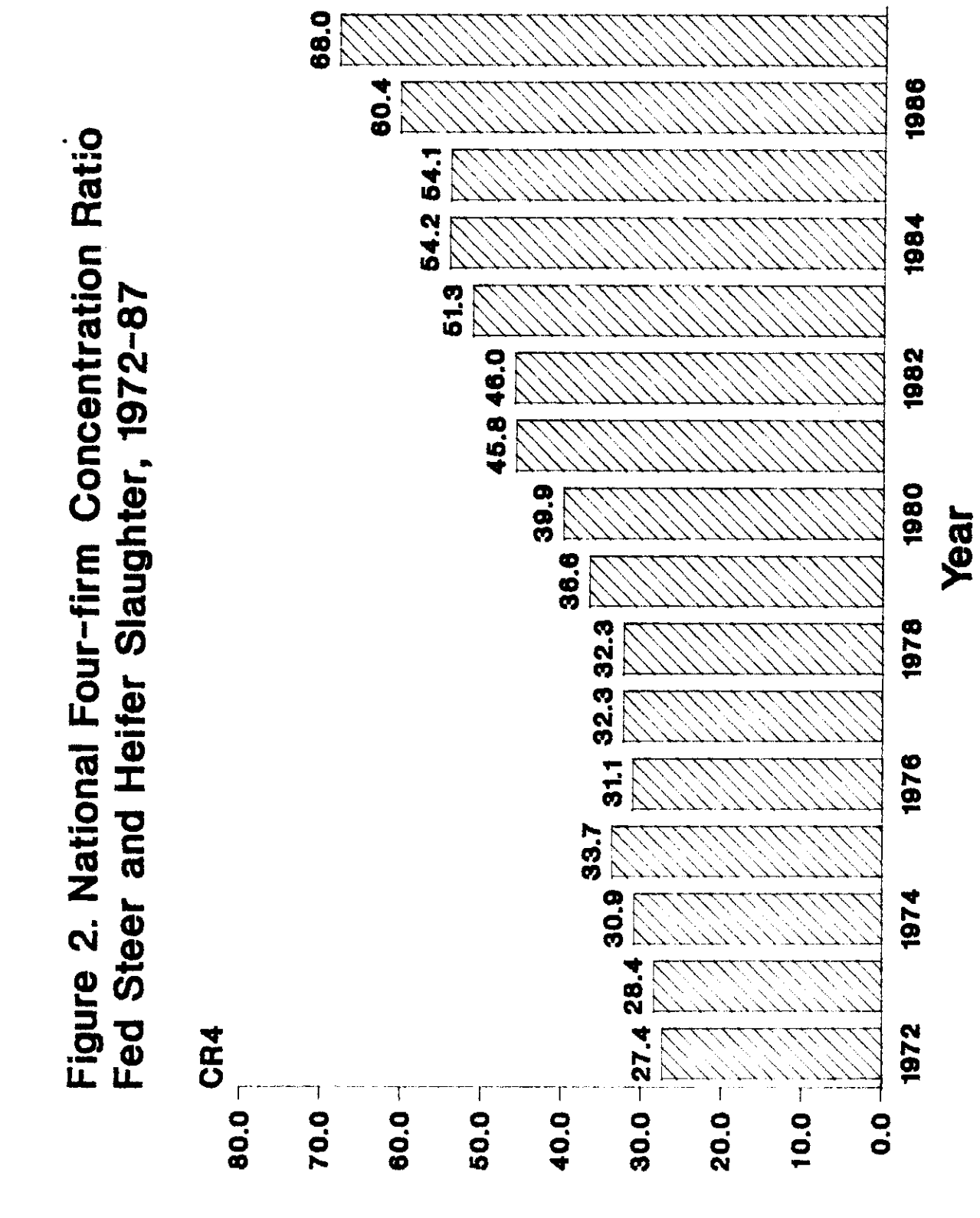
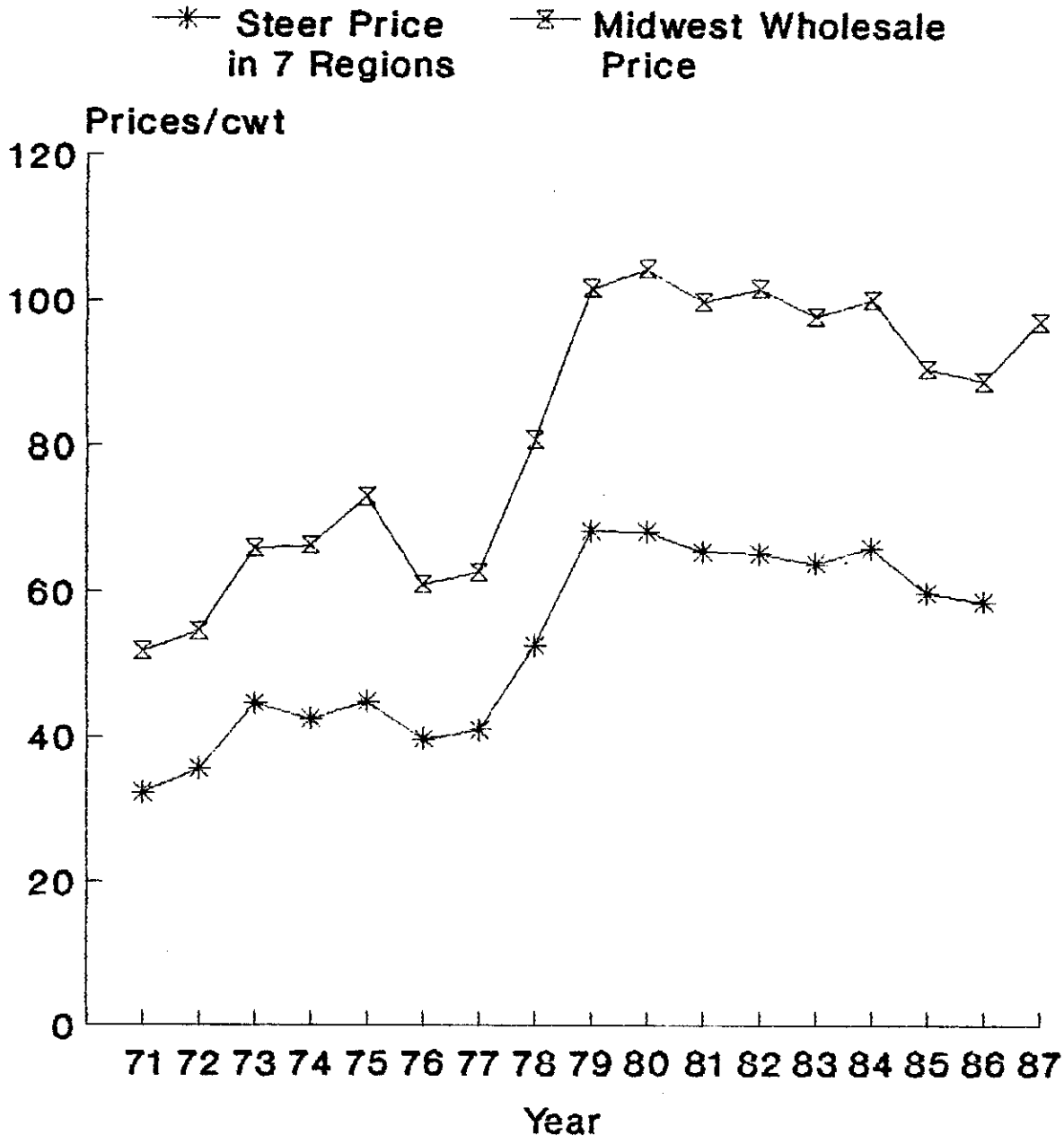


Figure 2. National Four-firm Concentration Ratio
Fed Steer and Heifer Slaughter, 1972-87
CR4
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
27.4
28.4
30.9
33.7
31.1
32.3
32.3
36.6
39.9
45.8
46.0
51.3
54.2
54.1
60.4
66.0
1972
1974
1976
1978
1980
1982
1984
1986
Year
Source: USDA, P&SA

Figure 3. Annual Live Cattle Prices and Midwest Wholesale Prices for Choice Steer Carcasses, 1971-87



and early 1980s poses a problem for empirical analysis of concentration-price relationships. Our initial analysis of monopsony power focused on 1971-1980. Pooled time-series cross section analysis revealed a significant negative relationship between regional buying concentration and live cattle prices (Quail et al, 1986). Monopsony power was indicated, albeit not particularly egregious. However, when regressions were run for individual years, the Herfindahl Index was the strongest during 1971-1974 and lost significance in 1980. One had to wonder -- what was going on?

In this paper, the earlier analysis (Quail et al) is extended through 1986. The results presented here are for several time periods. The 1971-1978 period is considered the most "normal". Results are also presented for 1979-1986, 1981-86 and for the entire period, 1971-1986. The primary analysis is pooled cross-section time-series in nature. Although most of our analysis uses cattle prices as the dependent variable, several regressions examine packer margins by region, using cattle price as a percent of the wholesale price. Finally, an effort is made to determine whether a critical concentration level exists in the markets examined.

Regression Results

Although the empirical models used for different time periods vary some, the basic theoretical model was:

$$P = f(B, S, PC, R, NSD)$$

Where:

P = Price of fed beef in each region. In most models, the annual average price for USDA choice steers (900-1100 lbs) in each region as reported by the USDA Market News was used. In some models, a measure of gross margin was used where cattle prices were

expressed as a percentage of wholesale carcass prices. Since the wholesale price used was the same for all regions for any particular year, variations in regional margins within any year are due to variations among regional cattle prices.

B = Structure of regional buying markets. Packer shares of the steers and heifers slaughtered in each region were calculated by Packers and Stockyards Administration. Several measures of concentration were provided to the authors by P & SA: CR_4 , $1/CR_2$ and the Herfindahl Index.

S = Structure of regional selling markets. This was measured by the percent of fed cattle that came from feedlots with capacity of 1000 head or more.

PC = Packer costs. Three variables were used to measure variations in packer costs that might be expected to influence derived demand. 1) Employee wages were measured by census wages for production employees in SIC 2011 (meat products) in each state for 1971-1978. An alternative measure was the percent slaughtered in each region by plants under the union master contract (1971-80). 2) Economies of large plants. This was measured by a zero-one binary variable to indicate the presence in a region of one or more plants slaughtering more than 250,000 head per year. 3) Distribution costs for carcasses or boxed beef. Since these products are sold

in a national market, this was measured by the distance of each region from either New York City or Los Angeles.

R = Rivalry or market turbulence. This was measured in two ways, relative share instability and percentage change in CR_4 from one year to the next. The latter is self explanatory. The former is the sum of the absolute change in the market shares of individual firms ranked in the top four.[8] A regional surplus-deficit variable was also tested in some models.[9]

NSD = National supply-demand. The effects of national supply (cattle cycle) and national demand on national prices are suggested by Figure 3. Two variables are used as surrogates of national supply-demand forces. Annual average midwest carcass price for U.S. choice steers is used in some models. In other cases, yearly dummy variables are employed.

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[8] The formula for relative share instability (RSI) for region i for 1978-79 was:

$$RSI_i = \sum_{j=1}^{4} \left| \frac{MS_{j78} - MS_{j79}}{MS_{j78}} \right|$$

Where MS_{j78} is the market share of the jth firm in 1978.

[9] The Surplus-deficit variable was measure by

$$\frac{M_{ij} - S_{ij}}{M_{ij}}$$

where:

M_{ij} = fed cattle marketed from farms in region i in year j.

S_{ij} = number of steers and heifers slaughtered in plants in region i in year j.

In addition to the above variables, a dummy variable for terminal markets was included in some models. Market News prices for four of the 13 regions were for terminal markets. Because transaction costs at terminal are higher than for direct sales, terminal prices are expected to be lower then direct sale prices. However, the volume sold through terminal markets also dropped sharply over the 16 years examined. In 1970, about 73% of fed cattle were sold direct; by 1987 this had increased to 91%. This shift is reflected in the increasing "thinness" of many terminal markets. Consider, for example, the volume of "cattle" (cows, bulls, steers and heifers) sold through the Omaha terminal and National Stockyards in St. Louis. Omaha terminal prices were not used in our analysis because prices for direct marketings in Iowa and E. Nebraska were available. National stockyard prices were used for Region 12 up through 1980, after which that region was dropped from the sample.

Annual Volume of Cattle

Terminal	1971	1980	1988
Omaha	1,240,000	746,000	229,855
National Stockyards	349,000	258,440	107,118

Tomek (1980) demonstrated that a terminal's prices become unrepresentative of the general price level for cattle when the volume sold through that terminal becomes very small. As terminals have declined in importance, there is the additional question of whether the leading packers bother buying at terminals. Put another way, is the concentration of slaughter among the top four packers in a region a good proxy for buyer concentration at the terminal markets in the region.

There is anecdotal evidence that terminals have become increasingly non-representative of the broader market during the 1970s and 1980s. Our statistical analysis for 1971-78 and 1971-80 also pointed in that direction. When the four terminal market regions were analyzed separately, no relationship between fed cattle prices and packer concentration was found. Conversely, when the direct market regions were analyzed without the terminal regions, the relationship between packer concentration and cattle prices was negative and highly significant. Additionally, because the terminal market regions were some of the smaller volume regions, data on fed cattle marketings and feedlot size became unavailable in 1981.

As a result of the above problems, the four terminal market regions were excluded from the analysis for 1981 to 1986. For earlier periods, the analyses were run both with and without the terminal regions.

Table 1 presents the regression results for 1971-78. Equations 1-4 included all 13 regions; equations 5-8 exclude the four terminal regions and regions 4 and 11, which have missing or unreliable data for some years.

In equations 2 and 4, the Herfindahl Index is significantly negative although only marginally so in equation 4. The Herfindahl Index (HI) and inverse CR4 (not shown) are slightly stronger then CR_4. All measures of concentration are highly significant when annual dummies are included. The use of the wholesale price for beef rather than annual dummy variables to control for national supply-demand conditions reduces substantially the "t" value on the concentration variable.

Of the remaining variables in the models, feedlot size has a significant positive relationship to cattle prices, as hypothesized. None of the variables measuring packer costs perform as hypothesized. Labor costs are

Table 1. Regression Results Explaining the Prices of Live Steers in Regional Markets, 1971-78.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	3279.51 (33.63)**	3269.39 (37.69)**	163.53 (1.29)	136.50 (1.06)	3254.97 (64.83)**	3245.37 (74.57)**	21.37 (0.12)	41.42 (0.26)
Herfindahl		-334.20 (-2.65)**		-313.74 (-1.60)+		-725.62 (-5.11)**		-562.67 (-1.73)*
CR_4	-91.19 (-1.30)~		-87.27 (-0.89)		-299.16 (-3.91)**		-223.93 -1.42~	
Labor	11.08 (0.80)	8.66 (0.69)	-2.19 (-0.16)	-4.67 (-0.35)				
Terminal	-32.02 (-0.60)	-32.33 (-0.91)	-16.02 (-0.30)	-6.32 (0.13)				
Distance	-0.041 (-0.78)	-0.039 (-0.95)	-0.063 (-0.91)	-0.056 (0.92)	.041 (0.84)	-0.016 (-0.46)	0.001 (0.01)	-0.025 (-0.32)
Feedlot	0.61 (1.40)~	0.89 (1.71)*	1.18 (1.41)~	1.32 (1.58)+	1.01 (2.97)**	1.32 (4.22)**	1.331 (1.63)*	1.39 (1.89)*
Plant Size	-47.25 (-1.93)	-45.54 (-2.10)						
Wholesale Beef Price			0.63 (32.03)	0.63 (32.37)**			0.64 (30.88)**	0.64 (32.02)**
Annual Dummy	Yes	Yes	No	No	Yes	Yes	No	No
NOBS	99	99	100	100	56	56	56	56
Type	EGLS	EGLS	EGLS	EGLS	EGLS	EGLS	OLS	EGLS

NOTE: t-statistics are in parentheses. Except for equations 3 and 5, parameters were estimated using the Prais-Winston procedure and corrected for heteroskedasticity.

** = significant at 1% level

* = significant at 5% level

~ = significant at 10% level

never significant. The plant economies variable generally has a negative sign rather than the positive sign hypothesized. The distance variable usually has the expected negative sign but is not significant.

The terminal market dummy varies in sign and is not significant. The terminal, distance and feedlot variables are highly collinear. When all three are included in the model, only the feedlot variable tends to be significant.

In the remaining analyses, the terminal market regions are excluded, allowing the terminal dummy to be dropped. Because of the insignificance or unexplainable results on the labor cost and plant economies variables, these are also dropped from future models.

The 1971-78 analysis in Table 1 attempts to explain variations in steer prices across regions and years. As we expand the period studied to include 1979-1986, the appropriate model and statistical procedure is more problematic. Figure 3 reveals considerable volatility in steer prices during the 1971-1986 period and a sharp break in prices between 1977 and 1979. One question is whether it is appropriate to pool data for 1971-77 with the data for 1979-86. If a shift in demand occurred in 1978-79, did the coefficients on our independent variables also change? Did the relationship between wholesale beef prices and steer prices change during this period? The answer appears to be yes to both of these questions.

The data in Appendix Table A confirm the visual impression in Figure 3: as wholesale prices moved to a new plateau in 1978 and 1979, the dollar margin per cwt also increased. Prior to 1979, dollar margins per cwt (wholesale price minus steer price) never reached $30. From 1979 to 1986, they have never dropped below $30.

However, as a percent of the wholesale price, steer prices increased. From 1977 on, annual average steer prices were 65 percent or more of the wholesale price in 9 out of 10 years. Prior to 1977, this was true in only 2 out of 6 years.

To further explore the appropriate statistical procedures, our base model was run for various time periods. Table 2 indicates the first order auto regression value (Rho), intercept term, CR_4 coefficient, and wholesale price coefficient for our base model (Cattle price = f(CR_4, Feedlot Size, Distance, Wholesale price) for time periods starting in 1971 but varying in ending years from 1975 to 1986. Table 3 provides similar information for time periods that end in 1986 but vary in starting year from 1971 to 1982.

In both of these tables, 1978-79 seems to be a watershed period. Both the intercept term and the coefficient on WP (wholesale beef price) change sharply during that period. In Table 2, the coefficient on wholesale price (WP) ranges from .61 to .64 for 1971-78 and earlier periods, but jumps to .68 to .70 for 1971-79 and later periods. CR_4 is negative throughout, but its "t" values are much higher in the later periods. In Table 3, a similar break occurs between the 1978-86 and the 1979-86 models. The coefficient on WP drops from .67-.69 to .56-.60 and the intercept term changes from a large negative to a large positive. The results in these tables suggest the inclusion of a dummy variable for 1971-78 when data are pooled for the entire 1971-86 period.

Four-firm concentration is negative and significant for most of the time periods examined in Tables 2 and 3. However, for short periods either at the beginning or end of the time period studied, CR_4 becomes insignificant. As more years are included in the sample, CR_4 tends to become more significant.

Table 2. OLS Results for Base Model with Four-Firm Concentration Ratio, Time Periods with Different Ending Years, Seven Regions

Years	Rho	Intercept	CR_4	WP	DFE
1971-75	.103 (.56)	167.76 (0.60)	-157.96 (-0.6[illegible])	0.61 (17.5[illegible])	30
1971-76	-.007 (-.04)	204.31 (0.83)	-205.11 (-1.002)	0.61 (19.0)	37
1971-77	.029 (.19)	214.14 (0.95)	-203.13 (-1.16)	0.61 (20.3)	44
1971-78	.074 (.52)	21.37 (0.12)	-223.93 (-1.42)	0.64 (30.9)	51
1971-79	.070 (.53)	-318.99 (-2.22)	-225.46 (-1.45)	0.70 (53.3)	58
1971-80	.026 (.21)	-250.87 (1.98)	-268.51 (-1.93)	0.69 (65.4)	65
1971-81	.052 (.44)	-246.59 (-2.12)	-267.22 (-2.18)	0.69 (71.1)	72
1971-82	.050 (.44)	-216.32 (-1.92)	-299.82 (-2.64)	0.68 (73.0)	79
1971-83	.065 (.60)	-259.56 (-2.40)	-263.98 (-2.54)	0.68 (75.4)	86
1971-84	.081 .77)	-281.79 (-2.69)	-227.82 (-2.34)	0.68 (78.0)	92
1971-85	.118 1.17)	-287.47 (-2.83)	-176.81 (-1.96)	0.68 (80.0)	98
1971-86	.147 (1.51)	-290.64 (-2.9[illegible])	-144.13 (1.72)	0.68 (82.1[illegible])	104

Note: t-values in parentheses.

Table 3. OLS Results for Base Model with Four-Firm Concentration Ratio, Time Periods with Different Beginning Years, Seven Regions

Years	Rho	Intercept	CR_4	WP	DFR
1971-86	.147 (1.51)	-290.64 (-2.97)	-144.13 (-1.72)	0.68 (82.1)	104
1972-86	.167 (1.66)	-250.55 (-2.35)	-140.72 (-1.63)	0.67 (74.6)	97
1973-86	0.100 (0.95)	-302.58 (-2.56)	-150.04 (-1.65)	0.68 (66.8)	90
1974-86	0.107 (0.97)	-433.15 (-3.73)	-146.92 (-1.70)	0.69 (70.2)	83
1975-86	0.071 (0.62)	-418.29 (-3.26)	-134.09 (-1.451)	0.69 (64.4)	76
1976-86	0.155 (1.29)	-271.40 (-2.61)	-231.33 (-3.10)	0.67 (80.3)	69
1977-86	0.141 (1.12)	-272.22 (-2.14)	-219.21 (-2.71)	0.67 (63.3)	62
1978-86	0.108 (0.80)	-254.05 (-1.26)	-220.36 (-2.47)	0.67 (35.6)	55
1979-86	0.237 (1.67)	395.58 (1.20)	-357.61 (-3.30)	0.60 (19.2)	48
1980-86	0.162 (1.04)	445.55 (1.63)	-183.81 (-1.35)	0.58 (22.4)	41
1981-86	-0.097 (-0.56)	571.60 1.93)	-105.86 (-0.96)	0.57 (19.5	34
1982-86	-0.059 -0.33)	605.47 (2.15)	-15.46 (-0.14)	0.56 20.1	27

Note: t-values in parentheses.

Appendix Tables B and C are comparable to Tables 2 and 3 except that HHI is used rather than CR_4. The "t" values on HHI are generally larger in Appendix Table B than for CR_4 in Table 2. However, when Table 3 and Appendix Table C are compared, HHI is consistently weaker than CR_4. For some reason, when 1986 is the end year of the period examined, HHI tends to be relatively weak. In Appendix Table B, the "t" on HHI is 1.3 or greater on 4 of 12 equations. When 1984 is used as the end year instead of 1986, 9 of the 12 equations have "t" values on HHI of that level. When 1985 is used as the end year, 8 of 12 equations had "t" values on HHI of 1.3 or greater (not shown).

Table 4 presents the regression results for several time periods, using CR_4 and wholesale beef prices in all models. Equations 1 and 2 indicate a significant negative relationship of CR_4 to cattle prices for the 1971-78 and 1971-80 periods. And equation 4 finds an even stronger negative relationship for the 1979-86 period. However, when the full period, 1971-86, is examined in equation 3, CR_4 drops to insignificance.

In equations 5 and 6, a dummy variable for 1971-78 is included. Comparing equations 3 and 5, the addition of the 1971-78 dummy increases sharply the intercept term, the negative CR_4 coefficient and "t" value, and drops the coefficient on wholesale beef price. CR_4 is negative but not significant in equation 3; in equation 5, CR_4 is significant at the 5 percent level.

In equation 6, the percent change in CR_4 from one year to the next is included as a short-term rivalry variable. Change in CR_4 is positive and marginally significant, suggesting that in those regions and years in which the leading firms increased their market share the most, they did so in part by paying higher prices for cattle. This is not surprising. Firms frequently

Table 4. Regression Results Explaining the Prices of Live Steers in Seven Regional Markets, Various Time Periods

	(1)	(2)	(3)	(4)	(5)	(6)
Period	1971-78	1971-80	1971-86	1979-86	1971-86	1971-86
Constant	21.37 (0.12)	-250.87 (1.98)+	-243.39 (-2.25)*	518.94 (1.61)+	315.24 (1.68)+	491.05 (2.46)*
CR_4	-223.93 (-1.42)+	-268.51 (-1.93)*	-91.37 (-1.04)	-318.27 (-2.55)**	-209.85 (-2.25)*	-249.89 (-2.58)**
Distance	0.001 (0.01)	-0.014 (-0.17)	-0.009 (0.94)	0.100 (1.30)	0.056 (0.94)	0.071 (1.13)
Feedlot	1.531 (1.68)*	1.738 (2.02)**	2.220 (2.83)**	2.862 (2.16)*	2.103 (2.45)**	2.149 (2.44)**
Pct Change in CR4	-	-	-	-	-	2.135 (1.584)+
Wholesale Price	0.640 (30.88)**	0.689 (65.44)**	0.668 (74.58)**	0.589 (20.56)**	0.614 (37.91)**	0.595 (34.54)**
1971-78 Dummy	-	-	-	-	-266.09 (-4.23)**	-307.94 (-4.77)**
NOBS	56	70	109	53	109	102
Type	OLS[a]	OLS[a]	EGLS[b]	EGLS[b]	EGLS[b]	EGLS[b]

[a]No statistical evidence of autoregression or heteroskedasticity was found.
[b]Corrections were made for first order autoregression and heteroskedasticity following procedures outlined in Judge et al, pp. 180-183 and Kmenta pp. 512-515.
** = significant at 1% level
* = significant at 5% level
+ = significant at 10% level

choose to sacrifice short-run profits in order to build market share and market power for the future. Our results suggest this was part of the dynamics of the beef packing industry during 1979-1986. Adding change in CR_4 to the model increased the coefficient and "t" value on CR_4 (compare equation 5 and 6.)

The intercept terms in Table 4 reflect the fact that the 1971-78 and 1979-86 periods experienced sharply different price levels. They vary from -250 for the 1971-80 model to +519 for the 1979-86 model.

Regression Examining Live Cattle to Wholesale Price Ratios

Instead of trying to explain live cattle prices, the ratio of steer prices to wholesale prices was used as the dependent variable in the regressions in Table 5. Annual average steer prices ranged from 61.3 to 67.6 percent of the wholesale price. Equations 1-3 are for 1971-86 and are identical except for the measure of concentration used. CR_4 and $1/CR_4$ are both significant at the 1% level with nearly identical "t" values. The Herfindahl Index is negative but not significant. A dummy variable for 1971-78 is used in these equations.

Equations 4-6 examine the price ratio during various time periods. CR_4 is negative and significant for 1971-78 (equation 4) and during 1979-86 (equation 5), but drops to insignificance during 1981-86 (equation 6). The price ratio is consistently higher in regions in which large feedlots are more important.

A possible explanation for the decline in significance of concentration in the 1980s is that coordination within or between packers reduced the geographic differences in price. There is some support for this in Appendix Table A. The coefficient of variation for steer prices across the seven

Table 5. Regression Results Explaining the Ratio of Live Cattle to Wholesale Prices in Regional Markets, Various Time Periods

Years	1971-86 (1)	1971-86 (2)	1971-86 (3)	1971-78 (4)	1979-86 (5)	1981-86 (6)	1971-86 (7)
Constant	64.61 (56.31)**	63.60 (49.52)**	61.17 (45.62)**	64.33 (35.16)**	63.92 (45.80)**	62.58 (54.90)**	61.17 (72.73)**
Herfindahl (HHI)		-1.002 (-0.99)					
CR_4	-2.578 (-2.51)**			-3.413 (-1.48)+	-2.406 (-1.97)*	-0.234 (-0.19)	-2.817 (-3.07)**
$1/CR_4$			1.084 (2.76)**				
Distance	0.000 (0.69)	-0.000 (-0.12)	0.001 (1.00)	0.000 (0.01)	0.001 (0.86)	0.000 (0.45)	0.000 (0.78)
Feedlot Size	0.027 (2.98)**	0.027 (2.42)**	0.023 (2.51)**	0.024 (1.77)*	0.030 (2.29)*	0.028 (2.62)**	0.027 (4.13)**
1971-78 Dummy	-1.750 (-4.55)**	-1.431 (-2.42)**	-1.750 (-4.70)**				
Annual Dummies	No	No	No	No	No	No	Yes
NOBS	109	109	109	66	53	39	109
Type	EGLS	EGLS	EGLS	OLS	EGLS	OLS	EGLS

regions averaged 1.71 during 1971-81 but only 1.06 during 1982-86. There was much less variation in most of our variables during the 1980s.

Equation 7 includes annual dummies for the period 1972-86. The results are similar to equation 1; however, the t-statistics are higher. It does not appear that the cattle cycle or other common annual effects have biased our results.

Critical Concentration Level

A critical concentration ratio, if one exists, has important implications for antitrust policy. Geithman, Weiss and Marvel comment:

> The critical concentration ratio can take two forms. The most common notion is that at some level of concentration industries become effectively collusive so that profit rates, price-cost margins, or prices rise to monopolistic levels. An alternative is that at some level concentration begins to affect performance. Below that level there is no relationship between concentration and performance, but above that level profits, margins, and/or prices rise with concentration. (p. 346)

The analysis summarized in Table 6 should reveal either type of critical concentration. Dummy variables were used for various levels of regional packer concentration. In equation 1, only two concentration levels show significantly lower prices at the 10% level. In equation 2 in which the 1971-78 dummy is added, four out of five concentration levels above $CR_4 = 60$ have significantly lower prices. There is no evidence of increasing coefficients as one goes from CR_4 of 60 to 65 to CR_4 of 80 or more. None of the cells for concentration levels less than 60 are even close to significance. The abrupt drop in prices at $CR_4 \geq 60$ suggests that as the critical CR_4. Prices in

Table 6. Regression Equations Testing for Critical Level of CR_4, 1971-86, Seven Regions

EQ NO.	(1)[1]	(2)[1]	(3)[2]
Type[3]	EGLS	EGLS	EGLS
Intercept	-344.29	257.62	393.69
(13)	(-2.85)**	(1.40)	(2.54)*
$40 \leq CR_4 < .45$	-4.80	-58.92	
(5)	(-0.06)	(-0.77)	
$45 \leq CR_4 < .50$	33.53	27.56	
(8)	(0.47)	(0.40)	
$.50 \leq CR_4 < .55$	-9.42	-41.43	
(9)	(-0.14)	(-0.61)	
$.55 \leq CR_4 < .60$	1.81	-33.43	
(14)	(0.03)	(-.52)	
$.60 \leq CR_4 < .65$	-92.82	-170.50	
(6)	(-1.14)	(-2.15)*	
$.65 \leq CR_4 < .70$	-94.80	-144.10	
(9)	(-1.42)+	(-2.24)*	
$.70 \leq CR_4 < .75$	-21.39	-60.17	
(7)	(-0.29)	(-0.87)	
$.75 \leq CR_4 < .80$	-85.60	-107.63	
(8)	(-1.31)+	(-1.74)*	
$.80 \leq CR_4$	-68.39	-162.84	
(30)	(-1.15)	(-2.69)**	
$.60 \leq CR_4$	---	---	-104.43
(60)			(3.25)**
1971-78 Dummy	---	-274.64	-309.68
		(-4.27)**	(5.14)**
Distance	-0.013	0.043	0.017
	(-0.21)	(0.76)	(0.31)
Feedlot	2.206	2.000	1.788
	(2.53)**	(2.42)**	(2.36)*
WP	0.678	0.619	0.597
	(77.30)**	(38.45)**	(34.01)**
F-Value	17,315	20,076	34,604
NOBS	109	109	109

[1]No correction for AR1; t statistics are in parentheses
[2]Correction for AR1 and Heteroskedasticity; t-statistics are in parentheses
[3]Number of observations are in parentheses
** = significant at 1% level
* = significant at 5% level
+ = significant at 10% level

regions with a $CR_4 \geq 60$ averaged $1.04 per cwt. less than prices in the remaining regions (equation #3).

Conclusions

The results presented in this article generally support the hypothesis that regional packer concentration was negatively related to live cattle prices. However, the results become more ambiguous if only the 1981-1986 period is examined. We believe there is considerable evidence of severe disequilibrium in the beef industry during 1979 to 1986. Although regional and national beef packer concentration was increasing sharply during this period, the effect of monopsony power on livestock prices is less evident than during 1971-1978. We believe this can be attributed to the major restructuring of beef packing that occurred, a shift in beef demand, excess capacity in the industry and rivalry among the market leaders to obtain the necessary supply of cattle to utilize their slaughtering and processing plants. As capacity exits the industry, we expect a new equilibrium will occur (perhaps has occurred). With extremely high levels of concentration both in regional procurement markets and in national wholesale beef markets, rivalry is likely to decline. Monopsony power and some degree of monopoly power is likely to become more apparent and more consistent.

We found some evidence of a critical concentration level in regional procurement markets. A four-firm concentration ratio of 60 or greater was associated with significantly lower prices paid for cattle. By 1983, the latest year for which data are available, all of the 13 regions in this study exceeded that level of concentration. The simple average regional CR_4 was 87. National CR_4 was 70 in 1988.

The measure of concentration that best fitted our data varied some over the time period. During the first half (1971-78), the Herfindahl Index performed more strongly than either CR_4 or the curvilinear version, $1/CR_4$. In the latter half of the period, CR_4 performed more strongly than the other two measures.

The beef packing industry has experienced a more rapid increase in concentration since 1977 than any industry we are aware of. Three firms now slaughter two-thirds of the steers and heifers in the U.S. Concentration is even higher in regional procurement markets. Based upon the evidence in this and many other industries, the levels and trends of concentration warrant serious concern for future competition.

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Appendix Table A. Summary Means and Coefficients of Variation for Seven Regions, 1971-86.

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Steer Price																
$\bar{X}$	3234.71	3557.71	4453.86	4424.14	4481.43	3959.57	4083.71	5253.14	6845.43	6832	6545.18	6523.46	6391.09	6598.74	5985.39	5862.05
CV[1]	1.357	1.040	1.345	2.371	1.363	2.534	2.011	1.628	1.519	1.778	1.829	.711	1.627	.8897	1.166	.304
Wholesale Price	5175	5456	6592	6642	7316	6096	6266	8080	10172	10439	9985	10168	9787	10017	9068	8900
Whol. Price -Steer Price	1940	1898	2138	2218	2835	2136	2182	2827	3327	3607	3440	3645	3396	3418	3082	3038
Gr. Mg.																
$\bar{X}$	62.51	65.21	67.56	63.90	61.26	64.95	65.17	65.01	67.30	65.45	65.55	64.16	65.30	65.88	66.01	65.37
CV	1.357	1.040	1.345	2.371	1.363	2.534	2.011	1.628	1.519	1.778	1.829	.711	1.627	.8897	1.166	.304
Herfindahl																
$\bar{X}$	.1036	.1156	.1241	.1164	.1169	.1222	.1169	.1301	.1560	.1875	.2567	.2926	.3142	.3016	.3134	.3233
CV	45.30	59.63	58.19	62.31	57.92	58.55	47.82	43.97	43.79	54.47	57.70	65.23	63.586	70.51	66.84	64.78
Wted Average[2]	.1015	.1179	.1264	.1163	.1133	.1210	.1134	.1270	.1548	.1793	.2070	.2179	.2399	.2482[3]	.2538[3]	.2628[3]
CR_4																
$\bar{X}$	.5044	.5283	.5612	.5301	.5347	.5636	.5539	.5793	.6366	.6996	.7687	.7859	.8228	.8083	.8283	.8557
CV	24.98	28.68	27.78	30.98	29.04	27.52	29.67	28.15	25.78	26.74	22.93	25.09	22.28	23.21	20.16	14.16
Feedlot Size																
$\bar{X}$	79.09	81.14	82.60	82.51	82.80	83.67	84.27	84.19	86.71	87.37	90.55	91.03	91.50	90.37	89.77	90.75
CV	31.69	29.71	27.30	28.25	28.42	26.58	25.07	24.94	20.88	19.73	17.22	16.97	16.98	16.94	20.82	19.38
Slaughter	18,501.36	18,995.07	18,098.83	16,368.38	18,703.46	19,812.63	21,654.19	20,508.92	19,972.52	19,085.51	20,261.12	20,723.52	21,278.37	20,033.89	20,764.51	20,497.32
$\bar{X}$	2643.14	2713.58	2585.55	2709.85	2671.32	2830.38	3093.46	2929.85	2853.22	2726.50	2894.45	2960.50	3039.77	3338.98	3460.75	3416.17
CV	101.27	98.03	99.58	98.82	98.04	88.56	90.70	100.02	89.30	99.24	107.17	110.42	107.25	105.28	107.30	114.21
CPI_{67}	121.3	125.3	133.10	147.7	161.2	170.5	181.5	195.4	217.4	246.8	272.40	289.10	298.40	311.10	322.2	328.4
No. of Regions	7	7	7	7	7	7	7	7	7	7	7	7	7	6	6	6

[1] CV = Coefficient of Variation = (Std. deviation / mean)*100

[2] Herfindahl weighted by slaughter

[3] Includes all seven regions.

Appendix Table B. OLS Results for Base Model with Herfindahl Index, Time Periods with Different Ending Years, Seven Regions

Years	Rho	Intercept	Herfindahl	WP	DF
1971-75	.085	169.30	-433.67	0.61	30
	(.46)	(0.62)	(-1.05)	(17.8)	
1971-76	-.024	203.48	-565.47	0.61	37
	(-.15)	(0.34)	(-1.47)	(19.3)	
1971-77	.007	213.64	-574.84	0.61	44
	(.05)	(0.97)	(-1.69)	(20.7)	
1971-78	.053	18.94	-609.30	0.64	51
	(.37)	(0.11)	(-1.35)	(31.6)	
1971-79	.053	-329.15	-608.25	0.70	58
	(.400)	(-2.32)	(-1.95)	(55.0)	
1971-80	.018	-269.39	-604.36	0.69	65
	(.14)	(-2.14)	(-2.26)	(68.2)	
1971-81	.052	-270.29	-473.33	0.69	72
	(.44)	(-2.31)	(-2.35)	(74.8)	
1971-82	.068	-241.57	-432.85	0.68	79
	(.60)	(-2.12)	(-2.70)	(77.7)	
1971-83	.104	-266.02	-395.43	0.67	85
	(.96)	(-2.41)	(-2.22)	(80.7)	
1971-84	.124	-275.46	-214.78	0.67	92
	(1.19)	(-2.53)	(-1.83)	(84.66)	
1971-85	.155	-277.61	-150.20	0.67	98
	(1.55)	(-2.70)	(-1.44)	(87.45)	
1971-86	.178	-279.45	-109.16	0.67	104
	(1.83)	(-2.83)	(-1.16)	(99.2)	

Note: t-values in parentheses.

Appendix Table C. OLS Results for Base Model with Herfindahl Index, Time Periods with Different Beginning Years, Seven Regions

Years	Rho	Intercept	Herfindahl	WP	DF
1971-86	.173	-273.45	-109.16	0.67	104
	(1.63)	(-2.83)	(-1.16)	(90.2)	
1972-86	.197	-236.62	-103.67	0.67	97
	(1.86)	(-2.22)	(-1.08)	(81.0)	
1973-86	0.134	-287.60	-110.96	0.67	90
	(1.28)	(-2.41)	(-1.11)	(71.9)	
1974-86	0.146	-415.27	-103.08	0.66	83
	(1.34)	(-3.55)	(-1.10)	(75.1)	
1975-86	0.114	-401.75	-90.31	0.68	76
	(1.00)	(-3.11)	(-0.92)	(68.3)	
1976-86	0.221	-244.52	-138.42	0.67	69
	(1.97)	-2.240	(-1.74)	(80.8)	
1977-86	0.204	-242.60	-125.97	0.66	62
	(1.82)	(-1.84)	(-1.51)	(62.6)	
1978-86	0.181	-254.60	-121.80	0.66	55
	(1.35)	(-1.22)	(-1.37)	(34.3)	
1979-86	0.251	92.76	-164.73	0.63	48
	(1.77)	(0.25)	(-1.67)	(19.5)	
1980-86	0.204	298.02	-60.74	0.60	41
	(1.31)	(1.11)	(-0.76)	(23.1)	
1981-86	-0.080	500.38	-16.37	0.57	34
	(-0.46)	(1.73)	(-0.21)	(20.0)	
1982-86	-0.059	531.30	41.40	0.56	27
	(-0.30)	(2.17)	(0.54)	(20.8)	

Note: t-values in parentheses.