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A Review of Causes for and Consequences of Economic Concentration in the U.S. Meatpacking Industry

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The Issue

> *This squall between the packers and the producers of this country ought to have blown over forty years ago, but we still have it on our hands ....*
>
> Senator John B. Kendrick of Wyoming, 1919

Clear and continuing changes in the structure of the U.S. meatpacking industry have significantly increased economic concentration since the mid-1970s. Concentration levels are among the highest of any industry in the United States, and well above levels generally considered to elicit non-competitive behavior and result in adverse economic performance, thereby triggering antitrust investigations and subsequent regulatory actions. Many agricultural economists and others deem this development paradoxical. While several civil antitrust lawsuits have been filed against the largest meatpacking firms, there have been no major antitrust decisions against those firms and there have been no significant federal government antitrust cases brought against the largest meatpacking firms over the period coincident with the period of major structural changes.

The structural changes in the U.S. meatpacking industry raise a number of questions. What is the nature of the changes and what economic factors caused them? What evidence is

there that economic behavior has shifted from competitive to non-competitive? What evidence is there that structural and behavioral changes have resulted in adverse economic performance? This paper reviews the available data and information pertaining to these questions and provides some insight into the answers. Structural changes are reviewed, along with discussion of one major causal factor for the changes. Then, numerous studies conducted over the past twenty years are reviewed, i.e., studies carried out at different times with alternative approaches and varying levels of data aggregation.

Implications and Conclusions

The research undertaken on structural change in the packing industry varies widely in terms of data, i.e., data unit aggregation (transactions to annual observations), collection length (one month to decades), and spatial aggregation (local market to the entire United States), as well as methodological approach, i.e., econometric estimation of models with several functional forms, simulation, game theory, conjectural variation, and combinations thereof. Once conclusion is clear – there is a dynamic, bi-directional linkage between structure, conduct, and performance.

Two additional issues also emerge from the research. The first centres on the fact that most of the research leads to questions of the form, "How large is large?" or "How small is small?" Price distortions of 3 percent or less were found in most studies. While these fall well short of regulatory agency standards related to merger impacts and non-competitive behavior, even seemingly small impacts on a $/cwt. basis may make a substantial difference to livestock producers and rival meatpacking firms operating at the margin of remaining viable or being forced to exit an industry.

A related issue revolves around the effects concentration will have on resource distribution over time and on the future structure of agriculture, both the production sector and the broader food sector, including processing and distribution segments. A short glance at the recent history of the livestock feeding and meatpacking industries should provide convincing evidence of the inter-relatedness among causes and consequences of structural changes.

Structural Changes Reviewed

> Only after considerable further 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, 1940)

Structural changes in the beef industry preceded similar changes in the pork industry. This review of structural changes focuses on steer and heifer slaughtering and fabricating and hog slaughtering.

In 1976, there were 145 steer and heifer slaughtering plants in the United States with annual slaughter of 50,000 head or more (Grain Inspection, Packers and Stockyards Administration, 2000). These plants slaughtered 22.4 million cattle. Plants with annual slaughter exceeding one-half million steers and heifers annually numbered 5 and accounted for 14.8 percent of slaughter by all firms in the over-50,000 head per year category. Average slaughter in these largest 5 plants averaged 666,800 head.

Comparable data for 1998 show major changes. The number of plants in the category of 50,000 head or more per year had declined to 38, but slaughter in these plants had increased to 26.7 million head. Fourteen plants each slaughtered one million or more cattle in 1998. These 14 accounted for 66.8 percent of total steer and heifer slaughter in the 50,000 head or more size group. Average slaughter per plant in the largest plants nearly doubled from 1976. Annual slaughter in the 14 largest plants averaged 1,274,400 head. The same trend is evident also for boxed-beef processing plants.

Not only did *plant* size increase, growth and consolidation resulted in larger beefpacking *firms* as well. There can be little argument that concentration in fed cattle slaughter and boxed-beef production is high by economists' standards. In 1976 for steer and heifer slaughter, the four largest firms accounted for 25.1 percent of total steer and heifer slaughter (a CR4 of 25.1) (Grain Inspection, Packers and Stockyards Administration, 2000). By 1998, the four largest firms accounted for 80 percent of total steer and heifer slaughter. Their share of boxed-beef production was even higher, 85.0 percent. It should be noted that the four largest firms in 1976 were not the same as the four largest firms in 1998. Mergers and acquisitions were largely responsible for the difference in leading firms. For example, a series of mergers and acquisitions in 1987 alone, involving some of the largest meatpacking firms, increased the CR4 in steer and heifer slaughter by 12 percentage points, from 55.1 to 67.1 (Grain Inspection, Packers and Stockyards Administration).

Porkpacking followed a trend similar to beefpacking but changes were not as dramatic. In 1976, there were 141 plants with annual slaughter of 50,000 or more hogs (Grain Inspection, Packers and Stockyards Administration). These plants slaughtered 66.0 million hogs and 12 of the plants had an annual slaughter exceeding one million head. Those 12 plants accounted for 28.5 percent of the total for plants with 50,000 or more hogs slaughtered per year. Average slaughter per plant in the 12 largest plants was 1,569,000 hogs.

The number of plants slaughtering 50,000 or more hogs annually had declined to 68 by 1998 but annual slaughter had increased to 90.3 million hogs. The number of plants slaughtering one million or more hogs annually increased to 30 and their share of total slaughter in the 50,000 head or more size group increased to 91.4 percent. Average slaughter for the 30 largest plants increased to 2,849,000 hogs.

As in the beef industry, growth and consolidation led to larger porkpacking firms also. The four largest hog slaughtering firms in 1976 had a combined market share (CR4) of 32.2 percent. Note the CR4 for hog slaughter two decades ago exceeded that for steer and heifer

slaughter. However, since then, the CR4 for hog slaughter has not increased as rapidly as it has for steer and heifer slaughter. The CR4 for hog slaughter reached 53.9 in 1998.

The sharp trend toward fewer and larger plants was driven by the enhanced economic efficiency and cost management associated with operating larger firms. Meatpacking is a margin business. Firms buy livestock at a small range around the market average price. Meatpackers do not control the market average price, because they control neither supply nor demand; but packers can influence prices paid around that average price level. They sell meat and by-products at a small range around the market average wholesale price. Again, they do not control the market average wholesale price but can influence prices received around that average price level. Thus, if gross margins are about the same for all firms, the firm with the lowest costs experiences the largest net margin or profit. Therefore, meatpacking firms search for ways to control costs per unit of output as a means of controlling net margins. As a result, one of the driving forces in meatpacking is the need to be a low-cost slaughterer and processor. And one way to achieve lower costs per unit is to operate larger, more efficient plants at near-capacity levels of utilization.

Studies in the 1960s (Logan and King, 1965), 1980s (Sersland as reported in Ward, 1988; Duewer and Nelson, 1991), and more recently (Paul, 2001; MacDonald et al., 2000) have found economies of size in cattle slaughtering and fabricating. MacDonald et al. compared their findings with those reported in two previous studies (see Ward 1993 for a detailed comparison of those studies). Sersland used survey data in 1985 for hypothetical plants and operating conditions from beefpacker management while Duewer and Nelson combined economic engineering and simulation with data for 1988. Both were essentially cross-section estimates, whereas the MacDonald et al. study was a time series analysis of Census of Manufactures data for 1963-92. The MacDonald et al. findings showed a slightly greater degree of size economies. A cost index comparison for a slaughter-fabrication plant at an annual output of 175,000 head for the three studies was 116.9, 111.2, and 130.7 for the Sersland, Duewer and Nelson, and MacDonald et al. estimates, respectively. For a 1,350,000 head plant, comparable index values were 81.3, 84.4, and 78.6. Thus, results were quite consistent and confirming of significant economies of size. Paul estimated cost functions with monthly, plant-level cost and revenue data for the 43 largest beefpacking plants in 1992-93. Results for cost economies were very robust. She found significant economies of size, consistent with earlier work.

Recent work also found economies of size in hog slaughtering (MacDonald and Ollinger, 2000). MacDonald and Ollinger examined time series Census of Manufactures data for 1963-92. They compared their findings with one previous study that used cross-sectional survey data for 1996-97 (Hayenga, 1998). Assuming reported average cost per head by Hayenga for large plants was indexed at 100, the estimate by MacDonald and Ollinger was 111.7 for a plant slaughtering four million hogs annually. Hayenga assumed full-capacity plant utilization, whereas MacDonald and Ollinger used data from actual plant utilization.

Less than full-capacity utilization leads to higher average costs compared with operating plants at full capacity (discussed further below).

Size-economies research confirms that firms operate larger beefpacking and porkpacking *plants* in order to be competitive. The consistent finding of economies of size is quite robust across a variety of approaches (i.e., economic engineering, simulation, and statistical cost analysis) and data (i.e., both cross-sectional and time series). While the magnitude of estimated economies differs, the overall finding is consistent.

Plant utilization also significantly affects operating costs. Having a larger plant pays dividends in terms of potentially achieving lower costs per head. However, to realize that potential advantage over smaller plants, larger plants also must operate at high levels of utilization. A larger plant at lower levels of plant utilization may in fact have higher costs per unit than a smaller plant operated at near-capacity utilization. Research has shown that larger plants operate at higher plant utilization than smaller plants (Ward, 1990; Barkley and Schroeder, 1996; Williams et al., 1996). Thus, larger plants have lower costs per unit than smaller plants both because they are larger and because they are operated at higher utilization. Paul concluded that larger, more diversified plants (i.e., in terms of processing operations) were more efficient when operated under higher rates of utilization. The importance of high plant utilization appeared in early economies-of-size studies (Sersland as reported in Ward, 1988; Duewer and Nelson, 1991) and has been found in subsequent work (Anderson and Trapp, 1999; Kambhampaty et al., 1996; Paul, 2001). The estimated extent varies, but the overall finding is consistent.

Economies of size lead to dynamic structural changes. An example is given here for beefpacking but would apply equally to porkpacking. When a firm expands a plant, say from one-half million cattle per year to one million cattle per year, e.g., either by expanding the plant or operating the plant at two shifts per day, the plant experiences lower per-head operating costs. Also, one-half million cattle previously slaughtered by other plants are now slaughtered in a single plant (*ceteris paribus*). Plants losing slaughter volume to the larger plant experience higher costs per unit because their plant utilization decreases. The result over time is that smaller plants experience higher costs and less profit, and go out of business, and concentration in meatpacking increases. Evidence of this dynamic element was found in a study by Anderson et al. of plants exiting the meatpacking industry over the 1991-93 period. Plant-level variables in their model, i.e., plant capacity, age, and extent of horizontal or vertical integration, significantly affected the likelihood of plants exiting the industry. Smaller or fringe competitors were more likely to exit already-concentrated markets. Smaller plants exit at higher rates than larger plants, due to smaller plants being less cost competitive.

The drive to operate larger, more efficient *plants*, capitalizing on economies of size, does not explain by itself the increase in *firm* size, such as via mergers and acquisitions. Internal growth as well as mergers and acquisitions have played significant roles in increased beefpacking concentration (Marion and Kim, 1991) and porkpacking concentration. One

factor leading to consolidation is economies of scope. Several aspects of economies of scope are relevant to meatpacking. First is the extent of processing activities within a single plant. These may involve slaughtering, fabricating, and hide and by-products processing. Paul (2001) found evidence that larger and more diversified plants (i.e., in terms of processing operations) have greater technological economies than smaller plants. A second aspect of scope economies involves firms with more than a single plant, i.e., multi-plant firms. Presumably, multi-plant firms operate at lower costs per unit than single-plant firms (assuming plants in both firms are a comparable size). Historically, these economies have been due to spreading overhead and administrative costs across several plants. Ward (1988) argued that multi-plant firms also have advantages in procuring livestock for one of several plants. Increasing pressures related to food safety suggest another advantage to multi-plant firms. Instances can be cited where a single-plant firm experienced a food-safety crisis that led to the firm's eventual demise. Third, there may be economies of scope available to firms that handle both beef and pork relative to firms that specialize in one or the other. These multi-species economies may occur in marketing by-products as well as meat to wholesale and retail buyers. While it is generally believed that economies of scope exist in meatpacking, little research to date has estimated their extent.

One clear trend concomitant with increasing plant size, firm size, and buyer concentration is increased livestock procurement by non-cash-price means, both in beef and pork (Ward et al., 2000). A survey of the 22 largest porkpacking firms in 1992 prophetically concluded that production and marketing contracts with pork producers would expand rapidly in the next decade (Hayenga and Kimle, 1992). For 1993, the largest porkpackers procured 87 percent of their hogs through cash market arrangements and the remaining 13 percent via various types of contracts (Hayenga et al., 1996). A survey of the largest porkpackers regarding hog purchases in January 2001 was compared to previous surveys for 1999 and 2000 (National Pork Producers Council, 2001). Over those three years, spot or cash market purchases declined from 35.8 percent to 25.7 percent to 17.3 percent, respectively. Note these percentages compare with 87 percent just a few years ago in 1993. The shift from cash market procurement to contracting and vertical integration has occurred abruptly. Note also that contracting involves at least two parties, and motives for each party may be distinctly different (Ward et al., 2000). Similarly, motives for entering into different types of contracts vary by the contract type.

The trend away from cash market procurement by packers is more gradual in the beef industry than in the pork industry (Ward et al., 2000). The first year the U.S. Department of Agriculture (USDA) collected data on contracting by the four largest beefpacking firms (1988), forward contracts and marketing agreements accounted for 15.8 percent of steer and heifer slaughter (Grain Inspection, Packers and Stockyards Administration, 2000). Since then, the highest level of contracting by the four largest firms was 19.3 percent the following year (1989); it was 18.9 percent for the most recent year reported (1998). Contracts in the

beef industry are of two primary types: forward contracts (typically basis contracts) and marketing agreements. Marketing agreements range from long-term supply contracts to looser forms of supply contracts. How contracting is defined is important. Many contracts are oral, and since the mid-1990s, grid pricing or carcass-merit pricing has increased in importance. Many of these transactions are formula-priced, and thus involve tying a base price to some reference market, often the spot-market price for a given time and geographic area. Since some transactions occur two or more weeks prior to the slaughter date, they are grouped with contracts by Grain Inspection, Packers and Stockyards Administration (GIPSA) and the Agricultural Marketing Service (AMS). Transactions with delivery within two weeks of the sale date are considered spot-market purchases, though some could be contracts. AMS reports non-cash-market purchases in their breakdown of feedlot volume as "additional movement" and this category of shipments is increasing sharply. For the first year such data were available, additional movements accounted for 19.6 percent of total shipments. The percentage increased to 32.4 percent, 34.9 percent, and 41.3 percent for the years 1998, 1999, and 2000. Therefore, one could argue contracting has increased and reliance on cash-market procurement has declined. But it needs to be recognized that not all of the additional movement percentages represent contract purchases.

While not a market structure characteristic, the limited information available on financial performance of the meatpacking industry may be instructive. Firm and industry financial data are sketchy, in part because some firms are privately held and do not report profits publicly. For publicly traded firms, some handle more than one species and report combined earnings for their meatpacking operations. Other firms report earnings for meatpacking in combination with related or unrelated operating divisions. Grain Inspection, Packers and Stockyards Administration collects financial performance data from meatpacking firms and has reported the data in summary form since 1992.

GIPSA defines operating income as gross income less operating expenses. Operating income as a percentage of sales for the four largest meatpackers has fluctuated over the 1992-98 period. It ranged from a low of 0.5 percent in 1992 to a high of 3.3 percent in 1995, and averaged 1.6 percent for the seven-year period. Clearly earnings rates have been variable. For many years, a 1.0 percent return on sales was considered a standard for the industry (Ward, 1988). The largest firms have exceeded that on average over the past several years. A higher profit rate may be attributed to greater efficiency, exercise of oligopoly or oligopsony market power, the move toward differentiated, branded meat items, or some combination of these factors.

One might assume that the largest firms are the most cost efficient, given that they presumably capitalize on economies of size and scope. However, profit rates for smaller meatpacking firms exceeded those for the largest firms over the 1992-98 period. The 40 largest meatpackers had operating income as a percentage of sales ranging from 1.2 percent in 1993 to 3.7 percent in 1995; their operating income averaged 2.2 percent for the seven-year

period. Higher earnings rates by smaller meatpackers seem inconsistent with the argument that the largest firms are the most efficient or that they have exercised oligopoly or oligopsony power. At least a portion of the higher returns to smaller firms may be due to their greater involvement in higher-value products for niche markets and higher returns for differentiated products that fit these markets.

Market and Firm Behavior and Performance Evidence

Research that addresses market behavior, either for individual firms or groups of firms (i.e., leading firms or the market as a whole), is linked directly or indirectly to market performance. Similarly, studies that attempt to measure market performance are implicitly or explicitly tied to market behavior. Thus, here a number of studies are reviewed that pertain to both behavior and performance. Studies are grouped into four interrelated, indistinct categories. Because an individual study frequently crosses category boundaries, one could argue with my choice of discussing them in a given section. Generally, research is discussed in chronological order based on the publication date.

Several studies, especially earlier ones, measure price impacts indirectly from market structure characteristics, without knowing anything about specific conduct or behavior. Examples include using such structural characteristics as number of buyers, bidders, procurement method, and buyer concentration to estimate effects on prices or margins. This approach tends to be associated with Bain's structure-conduct-performance paradigm. In recent years, an alternative approach based on estimating firm conjectures (the conjectural variation approach) has increased in popularity. These studies, which offer conjectures regarding buyer or seller behavior that leads directly to performance measures or outcomes, are sometimes categorized as "new empirical industrial organization" or "new industrial organization" research. Many economists consider the conjectural variation approach superior to the previous, indirect method of measuring price impacts from structural and behavioral changes. However, other economists note shortcomings of this approach and question its presumed superiority. (These arguments are discussed further below).

Price and Market Structure Characteristics

Several studies have examined the relationship between prices paid for livestock by meatpackers and various structural characteristics of the marketplace for the respective livestock species. These studies generally adhere to the underlying relationship in traditional industrial organization economics, where structural characteristics are causally related to performance outcomes (Bain, 1968). All research reviewed in this section estimates price-dependent econometric models, which typically hold constant many factors that influence prices, such as supply, demand, quality, quantity, time and place variables. Thus, the focus of the models and of this review is on the relationship between price and variables related to market structure, e.g., number of bids, number of bidders or buyers (i.e., plants and/or

firms), institutional considerations such as marketing/procurement methods, and buyer concentration.

Ward (1981) used transaction data from 1979 to empirically estimate the process packers described in pricing fed cattle. He found a positive, significant relationship between prices paid and either number of bids received or number of buyers bidding on each sale lot. Using the same data, he found that prices differed significantly between the smallest buyer and at least one larger buyer in half of the local markets he defined (Ward, 1982). Overall, larger buyers did not pay significantly lower prices than smaller rivals.

Annual data for several states in two years (1972 and 1977) were used to relate prices paid by packers and market structure variables, especially state-level concentration (Menkhaus, St. Clair, and Ahmaddaud, 1981). Results were consistent regarding the concentration variable. For both years, increased concentration was associated with significantly lower prices. The researchers concluded that the concern over concentration in beefpacking is warranted. It might be noted that concentration in steer and heifer slaughter for the United States during the two years they considered was 26 percent in 1972 and 27 percent in 1977.

Transaction data from 1979-82 were used to assess the importance and impact of competition on slaughter lamb prices (Ward, 1984). In alternative model specifications, prices paid varied among packers, and the largest buyer (based on market share of purchases) paid significantly lower prices than the smallest buyer. Prices increased significantly as the number of bidders increased, and price differences for the teleauction increased in its favor relative to a larger reference market as the number of bidders increased.

Another way to view potential competition is to consider the number of plants in a market area. Hayenga, Deiter, and Montoya (1986) examined the price impacts from closing and opening hog slaughtering plants in the Corn Belt region. Six plant closings during 1978-81 were studied, along with the re-openings of two of the plants in 1983. Using weekly data, transitory price declines lasting two weeks or more were found for four of the six plant closings and one of the two plant openings. Hayenga, Deiter, and Montoya concluded that concerns about adverse price impacts from plant closings may not be warranted. Adverse effects, when found, were temporary in nature until the market adjusted to the plant closing.

The development of a pilot electronic market for slaughter hogs in 1980 enabled the capture of transaction data, which allowed examination of the relationship between prices paid and increased buyer competition (Rhodus, Baldwin and Henderson, 1989). The researchers compared prices observed in HAMS (Hog Accelerated Marketing System) with reference markets for slaughter hogs. Prices received by producers marketing hogs through HAMS were higher relative to traditional hog markets during the 1979-81 period. The authors concluded that the electronic market enhanced prices to producers due to increased buyer competition.

Four-firm concentration in lamb slaughtering exceeded that for steer and heifer slaughtering and hog slaughtering until the early 1990s (Grain Inspection, Packers and Stockyards Administration, 2000). (Thereafter, concentration in steer and heifer slaughtering has exceeded concentration in lamb slaughtering.) Thus, concentration in lambpacking has been of concern to many people. Menkhaus, Whipple, and Ward (1990) used annual data for four states over the 1972-85 period to examine the effect the number of lambpacking plants had on prices paid for slaughter lambs. Results were inconclusive. Evidence was found that prices received by lamb producers in states with only one plant were significantly lower than in states with more than one plant. However, there was no significant difference in prices received in states with 2 to 5 plants compared with states that had more than five plants. They concluded that concerns are justified regarding non-competitive behavior when the number of plants declines to a single plant.

A series of mergers in 1987 changed the buyer landscape for fed cattle in the southern plains region and created what have since been called the "big three" packers. Ward (1992) collected transaction data in 1989 similar to that collected ten years earlier to determine whether buyer consolidation affected prices paid for fed cattle. Price differences were found among buyers and prices were positively and significantly associated with the number of buyers bidding on fed cattle. Both findings paralleled earlier work discussed above. Ward also grouped the three largest buyers into a single variable to determine price effects from the "big three" packers. Price differences were found among the three largest firms and between the three largest firms and other buyers. The three largest firms together paid significantly lower prices for fed cattle than did their rival firms in all local markets studied. However, when examined independently, not all of the three largest packers paid lower prices than their competitors.

Marion and Geithman (1995) used pooled cross-section time-series data to study the price-concentration relationship in 13 regional fed cattle markets over the 1971-86 period. They concluded that buyer concentration had a negative, significant effect on fed cattle prices during the study period. They estimated several model specifications, used alternative estimation methods, and divided the data into various time periods. Their results regarding the effects of concentration on fed cattle prices were mixed. When they estimated the effects for 1971-78 vs. those for 1979-86, they found that the concentration effect was negative in both periods but more severe in the latter period, which coincided with higher regional concentration. However, when the model for the entire period was estimated, the significance of the concentration variable disappeared. They included a variable in some models for the change in concentration and found a positive, significant effect on fed cattle prices. They explained the positive relationship as being due to larger buyers paying higher prices for fed cattle as they increased their market share.

Price and Pre-committed Livestock Supplies

Perhaps more contentious than the effects of concentration per se on livestock prices has been the effect of pre-committed livestock supplies on livestock prices. Pre-committed supplies were initially referred to in the beef industry, and later in the agricultural economics literature, as captive supplies. Pre-committed supplies refer to vertical integration of livestock by packers and various forms of contract coordination between livestock producers or feeders and packers. Several of the studies reviewed in this section also estimate price effects from pre-committed supplies using econometric models similar to those reviewed in the previous section. However, the focus of these models is on the relationship between prices and pre-committed supplies.

Elam (1992) estimated the effects deliveries of pre-committed supplies had on monthly average fed cattle prices in the United States and in selected individual states (Texas, Kansas, Colorado and Nebraska). Captive supply deliveries were inversely related to fed cattle prices over the period October 1988 to May 1991. For each 10,000 cattle delivered under captive supply arrangements, U.S. fed cattle prices declined by $0.03-$0.09/cwt., while for individual states results ranged from not significant to minus $0.37/cwt.

Schroeder et al. (1993) collected transaction data from feedlots in southwestern Kansas during May-November 1990 to examine the relationship between forward contracting (including marketing agreements) and transaction prices for fed cattle. They used two measures of forward contracts. One was contract deliveries as a percentage of the weekly total. The other was each packer's share of contract deliveries for each week. Results indicated a negative relationship between forward contracting and fed cattle prices, ranging from $0.15 to $0.31/cwt. over the six-month data period. Impacts also varied for two-month sub-periods and for individual packers. Price impacts were not significant for some packers and time periods. Related to findings discussed in the previous section of this paper, Schroeder et al. found a significant, positive relationship between the number of bids and the prices paid by packers. Also consistent with previous work, they found that prices paid by packers were significantly different over the data period.

Early work estimating price effects from pre-committed supplies lacked a strong theoretical framework identifying the motive(s) for beefpacking firms pre-purchasing cattle supplies. Azzam (1996) developed a conceptual framework for arguing the monopsony-inefficiency motive for integration by beefpackers to capture fed cattle supplies. He estimated the model empirically with aggregated, quarterly data for 1978-93. While the estimate of vertical integration from the model exceeded the level believed to exist, the model provides plausible but not conclusive evidence of the monopsony-inefficiency motive. However, he noted the monopsony hypothesis in the model should be interpreted cautiously.

Azzam (1998) further developed a conceptual model for estimating the price effects from pre-committed supplies, without incorporating a backward-integration motive. He found that price effects depend on a complex combination of several variables, among them the

respective fractions of cash-market and pre-committed procurement supplies. His model suggests that non-competitive conduct is not a necessary condition for negative effects on cash prices from pre-committed (i.e., captive) purchases. Thus, Azzam argued that previous work that suggested the inverse relationship between fed cattle prices and pre-committed supplies is due to non-competitive behavior is not defensible.

The most extensive, detailed data to study price impacts from pre-committed supplies were made available in a Congressionally mandated study on meatpacking concentration. Ward, Koontz, and Schroeder (1998) estimated price impacts with alternative approaches. They examined the interdependent nature of delivering cattle from three types of pre-committed inventories and purchasing fed cattle in the cash market. They also modeled the impact on transaction prices caused by the size of pre-committed supply inventories from which future deliveries could be made. Transaction data were collected from the 43 largest steer and heifer slaughtering plants, owned by 25 firms, for a one-year period, April 1992 to April 1993. They found that increasing deliveries of cattle from two of the three types of captive supply inventories were associated with lower transaction prices for fed cattle. A 1 percent increase in captive supply deliveries was associated with a $0.05/cwt. decline in fed cattle transaction prices for forward-contracted cattle and a $0.36/cwt. decline for marketing-agreement cattle. Simultaneity was found between cash-market transaction prices and percentage deliveries of forward-contracted and marketing-agreement cattle. Coefficients on individual captive supply inventory variables had mixed signs while the coefficient on the total captive supplies variable was not significant. A 1,000-head increase in the size of captive supply inventory was associated with: a $0.01/cwt. increase in transaction prices for the forward-contract inventory; an $0.18/cwt. decline for the packer-fed inventory; and a $0.02/cwt. decline for the marketing-agreement inventory. Related to the previous section, Ward, Koontz, and Schroeder found a positive and significant relationship between plant utilization and prices paid by packers, though the magnitude was small. Significant price differences were found among plants and firms. There was a tendency for plants paying the highest prices to be larger or located close to the primary cattle feeding area of Texas, Oklahoma, Kansas, Colorado and Nebraska.

Love and Burton (1999) developed a strategic rationale for backward integration by packers into livestock production or feeding. Their model included various forms of pre-committed supplies, or backward integration. Two sources of gains were identified. First, a dominant firm benefits from efficiency gains associated with expanded production. Second, in their model the integrating firm pays a lower price for pre-committed purchases. Love and Burton argued their results were consistent with previous research. For example, the Grain Inspection, Packers and Stockyards Administration studies found:

(a) beefpackers paid higher prices for marketing-agreement purchases than for cash-market purchases (Ward, Koontz, and Schroeder, 1998; Williams et al., 1996);

(b) higher rates of capacity utilization were associated with higher fed cattle prices (Ward, Koontz, and Schroeder);

(c) higher rates of capacity utilization were associated with higher rates of pre-committed supply usage (Barkley and Schroeder, 1996); and

(d) larger beefpacking plants paid higher prices than smaller plants (Ward, Koontz, and Schroeder; Williams et al., 1996).

These results were predicted by the Love and Burton model. They concluded that use of pre-committed supplies by beefpackers can be a potential source of market power. However, they noted that market power exertion may not be the prime motive for vertical integration.

Schroeter and Azzam (1999) used similar data to that used in the Ward, Koontz, and Schroeder study to examine the price and pre-committed supplies relationship. The Schroeter and Azzam study had access to transaction data from only four plants in the Texas Panhandle region but it covered a more recent period, February 1995 to May 1996. They found that packers expecting relatively large deliveries of non-cash-market cattle paid lower prices in the cash market. However, the magnitude was small. A 10 percent increase in pre-committed deliveries was associated with a $0.02-0.04/cwt. lower price. They stated their findings were generally consistent with previous studies. Schroeter and Azzam provided a logical rationale for this relatively consistent finding and cautioned that the negative relationship is not necessarily causal in nature, nor is it a sign of non-competitive behavior by packers. In addition they found, as in previous studies, that packing plants paid significantly different prices for fed cattle. Again, higher prices were found for fed cattle purchased under a marketing agreement than for fed cattle purchased in the cash market, even after adjusting for quality differences. Unlike Ward, Koontz, and Schroeter however, they also found one plant that paid higher prices for fed cattle purchased by forward contract, though they stated this may have been due to futures market conditions at the time of the study.

Zhang and Sexton (2000) employed a spatial model to illustrate how meatpackers can use pre-committed supplies strategically to influence cash market prices. Their model hinges on the importance of space (i.e., shipping costs relative to product value) to processors. As the importance of space increases, it becomes more likely that meatpacking plants will create geographic buffers between themselves, reducing competition in the cash market. Schroeter and Azzam examined the Texas Panhandle data to see if conditions matched those predicted by the Zhang and Sexton model. Two predictions implied from the Zhang and Sexton model were not verified by the Texas data. Those were that fed cattle procured by non-cash-market methods were shipped farther than those procured in the cash market, and that packers did not compete in their rivals' cash-market territory. Whether or not the scope of the geographic region and the data period were sufficient to adequately test the Zhang and Sexton model was not addressed.

Concentration and Margins

Marketing margins have been a topic of research interest in the agricultural economics profession for a long time. One point of interest is whether or not market structure characteristics affect marketing margins, i.e., farm-wholesale, wholesale-retail, or farm-retail. The basis for these studies is the presumed linkage between market structure and economic performance. Structural characteristics may allow firms to behave in a manner that leads to lower input prices, higher output prices, or a combination of both. In any of those cases, marketing margins would widen (*ceteris paribus*).

Schroeter and Azzam (1990) extended the conjectural variation approach from Schroeter to meatpacking firms processing more than one livestock species, i.e., beef and pork. Specifically, they estimated the degree of monopoly/monopsony power in farm-retail price spreads. They estimated their model with quarterly data for the period 1976 to 86. They found evidence of monopoly/monopsony conduct and estimated that nearly half of farm-retail price spreads for beef and pork (55 percent and 37 percent, respectively) could be attributed to monopoly/monopsony distortions. It should be noted that Schroeter and Azzam assumed fully integrated meatpacking firms and ignored all vertical relationships in the industry. They also noted data limitations in estimating the model.

Schroeter and Azzam (1991) developed a conceptual framework to decompose marketing margins into components, including oligopsony and oligopoly price distortions. They empirically applied the model to the porkpacking industry with weekly data for 1972-88. Note that during this period four-firm concentration ranged from 31.6 in 1972 to 33.5 in 1988 (Grain Inspection, Packers and Stockyards Administration, 2000). They found that oligopsony and oligopoly price distortions were not significant for the period studied, but also were not zero. In testing for differences in sub-periods (i.e., 1980s compared with 1970s), Schroeter and Azzam found evidence for less concern about oligopsony and oligopoly price distortions in the latter period than the earlier period, despite increased regional concentration in hog slaughter.

Brester and Musick (1995) used monthly data for 1980-92 to study the effect concentration in lambpacking had on farm-wholesale and farm-retail marketing margins. Results showed that increases in lambpacking concentration had small, positive effects on marketing margins, both farm-wholesale and farm-retail. However, Brester and Musick did not conclude that lambpacking firms used market power to lower slaughter lamb prices or raise retail prices, since the widening margins may have been associated with increased costs of processing as the industry converted from carcass to boxed-lamb processing and distribution.

One objective of an Economic Research Service study was to estimate the effect concentration has had on farm-wholesale and wholesale-retail marketing margins in the beef industry (Matthews et al., 1999). They estimated an asymmetric price adjustment model to determine whether or not price spreads change at the same rate when prices are decreasing as

when prices are increasing. They examined monthly data for 1979-96 and for the sub-period 1992-96. Using the Herfindahl-Hirshman Index (HHI) as the measure of concentration in beefpacking, they included it in the asymmetric price adjustment model. For the entire period, there was no significant effect on marketing margins from increasing concentration. However, for the sub-period there was a positive, significant effect. Thus, increased concentration was associated with higher fed cattle prices and lower farm-wholesale marketing margins. While unexpected based on the hypothesis of non-competitive behavior, the positive effect was small. Matthews et al. hypothesized that gains experienced from capitalizing on economies of size may be shared with cattle feeders, consistent with previous research (Ward, Koontz, and Schroeder, 1998; Williams et al., 1996).

Ward and Stevens (2000) approached the question of concentration impacts on marketing margins by examining price linkages from the producer-to-retail level in the beef chain. Data were monthly observations over the 1974-94 period. They found that increased beefpacker concentration has not translated into a weakening of the price linkage between producers and packers or between packers and wholesale (i.e., purveyors-processors). They found evidence that most of the pricing behavior change occurred at the retail not the packer level. They further noted that concentration has not adversely influenced the speed of price transmission in the beef chain. Thus, they concluded that increased beefpacker concentration had little aggregate effect on price linkages between producers and packers.

Oligopoly and Oligopsony Market Power

Several studies reviewed in this section reflect the increased preference for the conjectural variation approach. The intent is to measure directly the effect behavior has on performance, i.e., the existence of oligopoly/oligopsony (or monopoly/monopsony) price distortions and evidence of market power. However, other studies follow alternative approaches.

Schroeter (1988) was the first to apply the conjectural variation approach to beefpacking. He developed a conceptual framework and applied it to annual data for the 1951-83 period. He found significant conjectural elasticity estimates for 28 of the 33 years. Monopoly and monopsony price distortions were relatively modest according to Schroeter, about 3 percent and 1 percent, respectively. There was little evidence the degree of monopoly or monopsony distortion had increased during the later years of the study, when beefpacking concentration was beginning to increase sharply.

Azzam and Pagoulatos (1990) modified the conjectural variation approach to allow different conjectures for input and output markets. They estimated the model with annual, Census of Manufactures data for the meatpacking industry for the years 1959-82. Recall that during this period concentration in meatpacking was relatively low compared with later years. Azzam and Pagoulatos found non-competitive behavior in both the output and input markets. Further analysis revealed the extent of oligopsony power was significantly higher than that for oligopoly power.

One limitation of conjectural variation studies reviewed to date is the extent of data aggregation. Azzam and Schroeder (1991) recognized this problem especially as it relates to the input market for beefpacking where markets were believed to be more regional or local in nature. They developed a model to estimate oligopsony price distortions in 13 regional, fed cattle procurement markets. They calibrated the model to approximate the distortion across markets in 1986, then used simulation to determine the price distortion estimates for varying levels of regional beefpacking concentration and behavior. Subjecting the model to sensitivity analysis, they compared their results with previous research using econometric modeling. Azzam and Schroeder found slightly lower price effects across market areas, less than 1 percent of the price level, compared with about 1.2 percent to 2.5 percent across market areas or time periods in previous research (Ward, 1981; Menkhaus, St. Clair, and Ahmaddaud, 1981; Quail, et al., 1986). They concluded that their results indicated less danger of falling fed cattle prices (i.e., oligopsony price distortion) as a result of increasing buyer concentration than had been found in previous research.

Limitations of the conjectural variation approach were noted by Koontz, Garcia, and Hudson (1993). They argued that conjectural variations say nothing about optimal pricing strategies of firms and that often data used are highly aggregated. They studied non-competitive behavior in short-run pricing of fed cattle by beefpacking firms. Non-cooperative game theory was used to explain possible tacit collusion among rival packers. They showed that in order for collusive behavior to be optimal, rival firms follow a dual strategy. Firms will follow a cooperative pricing strategy at times and pay sub-competitive prices, while at other times they follow a non-cooperative strategy and pay competitive prices. Daily fed cattle prices from four regional markets for two time periods were used in the empirical estimation. Times chosen were two periods of relative structural stability in the beef industry, 1980-82 and 1984-86. They found evidence of oligopsony behavior consistent with trigger pricing strategies in all regions and both time periods. Their estimated conjectures of price distortion were in the range of 0.5 percent to 0.8 percent. However, they found a reduction in the oligopsony effect in the later period when buyer concentration was higher. Overall, behavior was consistent with cooperative pricing strategies.

Stiegert, Azzam, and Brorsen (1993) constructed a system of demand and supply equations in an imperfect market setting to examine pricing implications when fed cattle supplies are anticipated or unanticipated. They recognized that beefpacking firms are quantity-driven. Economies of size and utilization affect costs; which in turn directly affect profitability. Therefore, fed cattle supplies are critically important in measuring market behavior and its impacts. They used quarterly data for 1972-86. Their results suggest beefpacking firms follow average-cost rather than marginal-cost pricing, consistent with Ward's (1988) hypothesis and other research. Fed cattle were priced below marginal value in 31 of 59 quarters. The markdowns during periods of anticipated supply were consistent with average-cost pricing. Packer response to unanticipated supplies suggested that pricing

response is dependent on the size of the supply shock. Small shocks tend to be associated with average-cost pricing. They concluded that decreasing buyer concentration is unlikely to result in improved (i.e., higher) fed cattle prices.

Economies of size suggest increased efficiencies have occurred over time in meatpacking as structural changes have taken place. Several studies also have found oligopoly or oligopsony price distortions associated with the same structural changes, and leading to increased concentration in meatpacking. Azzam and Schroeder (1995) addressed the trade-offs in efficiency gains and oligopsony losses. They developed the model for the beefpacking industry in general, and then specifically for regional fed cattle procurement. They used a baseline period which corresponds in their estimation to the 1986-88 period, then used sensitivity analysis to consider impacts from further structural changes (i.e., increases in regional concentration but lower processing costs) and increased oligopsony pricing. Overall they found that when consolidation leads to economies-of-size efficiencies and increased oligopsony pricing behavior, even modest efficiency gains offset the oligopsony or welfare losses. They estimated that cost savings of 2.4 percent or less would offset anti-competitive effects from a 50 percent increase in beefpacking concentration. Their estimate of actual cost savings was 4 percent. Thus, they concluded structural changes have been welfare enhancing in the beefpacking industry.

Concomitant with structural changes in the meatpacking industry has been the decreased consumer demand for red meats (Purcell, 2000). Weliwita and Azzam (1996) considered declining demand's impacts on beefpacking behavior. They argued that an oligopoly or oligopsony will behave as a cartel and become more competitive with an unexpected decline in output demand. In a game theory framework, firms will not distinguish between declining demand and rivals cheating, thus inducing a punishment period. Weliwita and Azzam tested for cooperative pricing behavior after unexpected declines in beef demand. They developed the conceptual model and applied it to quarterly data for 1978-93. Results indicated that declining demand did not increase the competitiveness of packers, either in fed cattle or beef markets. Packers did not follow a cooperative pricing strategy either in fed cattle or beef markets. Oligopsony price distortions of about 2.7 percent were found, within the range of those found in previous research.

Driscoll, Kambhampaty, and Purcell (1997) tested for short-run profit-maximizing behavior of beefpacking firms. They argue that if profit maximization is not followed, then estimates of conjectural elasticities are biased. They devised a nonparametric test for profit maximization and applied it to weekly data from 15 plants in two regions for a one-year period in 1992-93. They applied the test to weekly, plant-level data, then merged data into four levels of aggregation, ultimately to monthly, firm-level data. They found, both for weekly and monthly data, that plants and firms did not appear to follow profit-maximizing behavior. Plants regularly operated at production levels below those needed to achieve static profit maximization. Results were consistent with hypothesized behavior proposed by Ward

(1988), that meatpacking firms use average-cost pricing and may be profit satisficers. Driscoll, Kambhampaty, and Purcell found very little evidence of oligopolistic or oligopsonistic behavior when profit maximization was assumed, consistent with small price distortions found in previous research. They argued that use of conjectural variations is inappropriate when short-term, static profit maximization is assumed. However, they did not rule out profit-maximizing behavior over several periods.

According to Muth and Wohlgenant (1999), one assumption commonly, and arguably incorrectly, made in conjectural variation studies is that of fixed-proportions technology. They developed a model relaxing this assumption in favor of variable proportions or substitutability among the non-specialized inputs. They contended their approach requires less data in the empirical estimation process and applied the model to annual data for 1967-93. They found negligible oligopsony price distortion, contrary to previous models using fixed proportions.

Koontz and Garcia (1997) extended the Koontz, Garcia, and Hudson (1993) non-cooperative game to measure the competitiveness of beefpacking firms across regional fed cattle markets. Multi-plant firms encounter each other in multiple markets. The Koontz and Garcia model enables accounting for firm behavior in all relevant markets. They used daily data from eight regional fed cattle markets for the periods 1980-82 and 1984-86. Multiple-market oligopsony was found across geographic fed cattle markets and evidence indicated coordinated behavior across markets. The oligopsony finding was consistent with previous research on single-market oligopsony. Also consistent was the finding that the extent of oligopsony was small and that the effect was greater in the earlier period than the latter period, despite regional concentration being higher in the latter period. Overall, Koontz and Garcia concluded that oligopsony behavior in fed cattle procurement is non-constant over time and space.

While oligopsony/oligopoly price distortions have been found in some studies, Schroeter, Azzam, and Zhang (2000) explored the oligopoly question in relation to the retail market. Specifically, they developed a model to test for bilateral oligopoly of meatpacking and retail firms, but allowed for oligopoly behavior by packers and oligopsony behavior by retailers. Using monthly data for 1990-94, they concluded the data best fit a model of oligopsony behavior by retailers. They found that meatpackers were price-takers with little or no evidence of oligopoly behavior.

Paul (2001) estimated oligopoly and oligopsony power with monthly, plant-level cost and revenue data for the 43 largest beefpacking plants for a one-year period in 1992-93. She also estimated cost functions and found results both for cost economies and market power to be very robust. Her findings confirmed significant economies of size, as discussed above. In addition, she found little evidence of price-depressing, oligopsonistic effects for fed cattle. Her findings were consistent with the previous research on trade-offs between cost efficiency gains and oligopsony losses (Azzam and Schroeter, 1995).

Summary of the Evidence and Concluding Comments

Tables 1 to 4 summarize the research reviewed in this paper. One point is clear. Research varies widely in terms of data, i.e., data unit aggregation (transactions to annual observations), collection length (one month to decades), and spatial aggregation (local market to the entire United States), as well as methodological approach, i.e., econometric estimation of models with several functional forms, simulation, game theory, conjectural variation, and combinations thereof.

Azzam and Anderson (1996) conducted an extensive review of competition in meatpacking. In their summary, they offered criticisms both of the structure-conduct-performance approach and the conjectural variation approach. They concluded the body of empirical evidence was insufficient to argue persuasively the meatpacking industry was not competitive. Sexton (2000) reported on more recent critiques of the conjectural variation approach. Despite the weaknesses of the approach, he concluded that market power estimates in meatpacking (i.e., the focus of much of the conjectural variation literature) are modest, and structural changes on balance are probably beneficial from an efficiency viewpoint.

In reviewing the available evidence, my interpretation appears consistent with theirs. Examining the evidence in the tables, either by data aggregation, methodology, or time period, yields little difference in interpretation. Research shows a dynamic, bi-directional linkage between structure, conduct, and performance. This exhibits itself in the research that measures indirectly the linkage between structure and performance as well as in the research that measures directly the linkage between behavior and performance.

It seems both the structure-conduct-performance approach and the conjectural variation approach share a related weakness. In the Bainsian structure-conduct-performance approach, excessive emphasis is placed on a single structural characteristic, i.e., the concentration ratio or HHI, as a predictor of conduct and performance. In the conjectural variation approach, emphasis shifts to a single conduct variable, i.e., the conjectural variation coefficient, as a descriptor of conduct and predictor of performance. In either case, relatively little emphasis is placed on the "how" and competitive dynamics, especially of rivals' reactions.

Besides the "how" of exercising market power, two additional central issues emerge. The first centres on the fact that most of the research leads to questions of the form, "How large is large?" or "How small is small?" Price distortions of 3 percent or less were found in most studies. These fall well short of regulatory agency standards related to merger impacts and non-competitive behavior, which often assume a 5 percent price impact rule (U.S. Department of Justice and Federal Trade Commission, 1997). However, the courts and regulatory agencies have defined specifically neither how much market power is "significant" nor for how long a firm or firms must maintain significant market power (Carlton and Perloff, 1994).

From another viewpoint, seemingly small impacts on a $/cwt. basis may make a substantial difference to livestock producers and rival meatpacking firms operating at the

margin of remaining viable or being forced to exit an industry. In relatively low-profit businesses, "small" degrees of market power can have significant profit implications. Even "small" $/cwt. or percentage impacts represent large total-dollar sums, especially summed over long time periods. To some, these provide clear targets for antitrust lawsuits, conclusive evidence of lax antitrust enforcement, and undeniable grounds for corrective legislation.

A related issue revolves around comments made by Sexton (2000) and examined further in Sexton and Zhang (2001). Given the bi-directional dynamics stemming from structure-conduct-performance relationships, concentration impacts have implications for resource distribution over time and for the future structure of agriculture, both the production sector and the broader food sector, including processing and distribution segments. A short glance at the recent history of the livestock feeding and meatpacking industries should provide convincing evidence of the inter-relatedness among causes and consequences of structural changes. Sexton and Zhang addressed the issue of market power from the standpoint of adjacent segments of the marketing channel and potential effects on resource distribution. They argued the emphasis on performance should be broader than simply efficiency, and should encompass welfare distribution effects as well.

Having spoken to producer groups for 25 years, followed structural changes in meatpacking during that time, conducted some of the relevant research, and reviewed others' research pertinent to the issue, I have frequently had a question posed to me: What should be done or what can be done to reverse the trend? Some people of course want to do nothing and allow the market to function unencumbered by external regulations and constraints. Some people want to turn back the clock. They would administratively alter the market structure where problems seemingly occur, that is, they would break up large meatpacking firms initially and restrict presumably problematic behavior, i.e., eliminate contracting and vertical integration. Some people want to treat agriculture as a unique sector of society and create laws and regulations applicable to agriculture alone, regardless of whether or not they apply to other sectors of the economy. Relatively little thought is given in many cases to public and private costs, or to public and private benefits, of these alternatives, even though the sector is codependent with the rest of the economy.

Evidence of structural changes is clear and conclusive. Research findings on causes and consequences, while less clear, are relatively robust considering the diversity of data and myriad of approaches. Economists have contributed relatively little, perhaps as should be the case, to policy alternatives and prescriptions dealing with structural change issues. Two divergent alternatives arise implicitly through all the research conducted to date. One is to do virtually nothing, allow economics to dictate the future, and simply continue conducting research to measure and monitor the impacts of rising concentration. The other is to advocate, perhaps without clear research to assess impacts and guide decision-making, for more intrusive governmental actions aimed at limiting harmful changes and impacts. Neither may be very satisfying to agricultural producers and policymakers.

Table 1 Summary of Relevant Research on Price and Market Structure

Research Category and Study	Data Time & Space Aggregation	Data Period	Major Relevant Findings, Conclusions
Ward 1981	Transactions, Local	1979	Positive relationship between fed cattle prices and number of buyers or bidders
Ward 1982	Transactions, Local	1979	Fed cattle price differences between smaller and larger buyers
Mehkhaus, St. Clair, and Ahmaddaud	Annual, State	1972, 1977	Higher concentration associated with lower fed cattle prices
Ward 1984	Transactions, Local	1979-82	Positive relationship between slaughter lamb prices and number of bidders Slaughter lamb price differences between smaller and larger buyers
Hayenga, Deiter, and Montoya	Weekly, Local	1978-81	Temporary price declines (increases) when hog slaughter plants closed (opened)
Rhodus, Baldwin, and Henderson	Transactions, Local	1979-81	Higher slaughter hog prices associated with increased buyer competition
Menkhaus, Whipple, and Ward	Annual, State	1972-85	States with one slaughter plant associated with lower slaughter lamb prices
Ward 1992	Transactions, Local	1989	Positive relationship between fed cattle prices and number of buyers bidding Fed cattle price differences between smaller and larger buyers Lower fed cattle prices associated with "Big 3" packers
Marion and Geithman	Annual, Regional	1971-86	Higher concentration associated with lower fed cattle prices

Table 2 Summary of Relevant Research on Price and Pre-committed Supplies

Research Category and Study	Data Time & Space Aggregation	Data Period	Major Relevant Findings, Conclusions
Elam	Monthly, State	1988-91	Lower fed cattle prices associated with higher deliveries of pre-committed supplies
Schroeder et al.	Transactions, Local	1990	Lower fed cattle prices associated with higher levels of forward contracting Positive relationship between fed cattle prices and number of bids Fed cattle price differences between buyers
Azzam 1996	Quarterly, U.S.	1978-93	Evidence of monopsony-inefficiency motive for vertical integration of fed cattle procurement by packers
Azzam 1998			Conceptual model of packer use of pre-committed supplies suggests an inverse relationship between price and pre-committed supplies is not due to non-competitive behavior
Ward, Koontz, and Schroeder	Transactions, U.S.	1992-93	Lower fed cattle prices associated with increased deliveries of two types of pre-committed supplies Positive relationship between fed cattle prices and higher plant utilization Fed cattle price differences between plants and firms Higher fed cattle prices near the centre of price discovery
Love and Burton			Conceptual model of packer use of pre-committed supplies suggests that packers pay a lower price for pre-committed supplies and that pre-committed supplies increase plant efficiency
Schroeter and Azzam 1999	Transactions, Regional	1995-96	Lower fed cattle prices associated with increased deliveries of pre-committed supplies Higher fed cattle prices associated with one type of pre-committed supplies Fed cattle price differences between plants and firms
Zhang and Sexton			Conceptual model of packer use of pre-committed supplies suggests packers may create a geographic buffer between them, reducing competition and resulting in lower prices paid for livestock

Table 3 Summary of Relevant Research on Concentration and Margins

Research Category and Study	Data Time & Space Aggregation	Data Period	Major Relevant Findings, Conclusions
Schroeter and Azzam 1990	Quarterly, U.S.	1976-86	Evidence of monopoly, monopsony behavior by packers in beef and pork
Schroeter and Azzam 1991	Weekly, U.S.	1972-88	No significant oligopoly, oligopsony price distortions for pork
Brester and Musick	Monthly, U.S.	1980-92	Increased concentration associated with higher farm-wholesale, farm-retail marketing margins for lamb
Matthews, Jr. et al.	Monthly, U.S.	1979-96	No significant association between increased packer concentration and marketing margins for the entire period Increased concentration associated with higher fed cattle prices and lower farm-wholesale margins for the 1992-96 sub-period
Ward and Stevens	Monthly, U.S.	1974-94	Little aggregate effect on beef industry price linkages from increased packer concentration

Table 4 Summary of Relevant Research on Oligopoly and Oligopsony Market Power

Research Category and Study	Data Time & Space Aggregation	Data Period	Major Relevant Findings, Conclusions
Schroeter	Annual, U.S.	1951-83	Modest monopoly, monopsony price distortions in 28 of 33 years
Azzam and Pagoulatos	Annual, U.S.	1959-82	Evidence of oligopoly, oligopsony behavior in input and output markets Extent of oligopsony exceeded that for oligopoly
Azzam and Schroeter 1991	Annual, Regional	1986	Small price distortions from simulations of increasing concentration in regional fed cattle markets
Koontz, Garcia, and Hudson	Daily, Regional	1980-82, 1984-86	Evidence of oligopsony behavior consistent with trigger pricing strategies Decreased oligopsony impact in the latter time period
Stiegert, Azzam, and Brorsen	Quarterly, U.S.	1972-86	Beefpackers follow average-cost pricing Decreasing concentration will not likely improve fed cattle prices
Azzam and Schroeter 1995	Annual, Regional	1986-88	Economies of size efficiencies more than offset oligopsony price distortions for fed cattle Structural changes have had a welfare-enhancing effect
Weliwita and Azzam	Quarterly, U.S.	1978-93	Declining demand not associated with increased competitiveness of packers for fed cattle or beef Oligopsony price distortions were found
Driscoll, Kambhampaty, and Purcell	Weekly, Regional	1992-93	Plants and firms did not follow short-run profit-maximizing behavior Little evidence of oligopoly, oligopsony behavior
Muth and Wohlgenant	Annual, U.S.	1967-93	Negligible oligopsony price distortion
Koontz and Garcia	Daily, Regional	1980-82, 1984-86	Evidence of multi-market oligopsony behavior across geographic markets Oligopsonistic behavior is not constant over time or space
Schroeter, Azzam, and Zhang	Monthly, U.S.	1990-94	Evidence of oligopsonistic behavior by retail firms Little evidence of oligopolistic behavior by meatpacking firms
Paul	Monthly, Regional	1992-93	Little evidence of oligopsony behavior by beefpackers Economies of size efficiencies more than offset oligopsony price distortions for fed cattle

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