Invited paper

Competition in the US meatpacking industry: is it history? [1]

Azzeddine M. Azzam [*]

Department of Agricultural Economics, 207C Filley Hall, University of Nebraska-Lincoln, Lincoln, NE 68583-0922, USA

Abstract

The US meatpacking industry has become concentrated to a degree not experienced since the days of the 'Beef trust' a century ago. A number of mainstream studies have investigated if such concentration has been detrimental to competition. Just as earlier studies may have helped shape competition policy towards meatpacking a century ago, contemporary studies have made their way into current discussions and may shape competition policy at the turn of this century. This paper asks whether or not contemporary studies are useful in informing competition policy. After comparing how competition *looks* from the econometric vantage point with how it *looks* from the vantage point of the industry's 300-yr history, this article concludes that mainstream studies are more useful for a competition policy targeting conduct rather than structure. Published by Elsevier Science B.V.

Keywords: US meatpacking industry; Concentration; Competition policy

1. Introduction

Over the past 2 decades, the US meatpacking industry has undergone a radical structural change to a degree not experienced since the days of the 'Beef trust' a century ago. According to the Packers and Stockyards Administration (1996), the total number of livestock slaughter plants declined from 6156 in 1972 to 3763 in 1994, a drop of almost 40%. The largest decline in slaughter plants was for steers and heifers (71%), followed by hogs (57%), and sheep and lamb (52%), with the bulk of slaughter shifting to larger size plants. Plants slaughtering 1,000,000 head and more per year accounted for over half of all the steer and heifer slaughter, and 87% of all the hog slaughter. Over 78% of all lamb and sheep slaughter took place in plants with 300,000 head and more capacity. Over the same period, the four-firm concentration ratio increased in percentage terms from 29 to 81 for steers and heifers, from 32 to 44 for hogs, and from 57 to 76 for sheep and lamb.

Livestock producers, policy makers and others often point to such 'high' concentration levels as evidence of what they perceive as deteriorating competition in the industry, especially when the top four beef-packers also produce 85% of all the (boxed)

* Corresponding author. Tel.: + 1-402-472-5326; fax: + 1-402-472-3460; email: iacd019@unlvm.unl.edu.

[1] This is an abridged and updated version of a larger report (Azzam and Anderson, 1996) submitted to the Packers and Stockyards Administration (now Grain Inspection, Packers and Stockyards Administration) as part of a government-financed study of concentration in the red meat packing industry. Some of the text is verbatim from the original report.

beef sold to retailers. The prevalent claim, voiced also a century ago, is that heightened concentration facilitates collusion among packers, resulting in depressed livestock prices and elevated meat prices. An unprecedented number of empirical studies have recently investigated if that is the case. Some were done along the traditional lines of the Structure–Conduct–Performance (SCP) paradigm; others were based on more recent methods from what has become known as the New Empirical Industrial Organization (NEIO).

Just as earlier empirical research may have helped shape competition policy affecting the industry at the turn of the last century, contemporary research findings have made their way into current debates and may shape competition policy at the turn of this century. Also, just as the issue of market power in the industry a century ago was debated concurrently with a major tension between classical and neoclassical economics, the issue nowadays is being debated concurrently with major reformation of empirical research in industrial economics. The difference, however, is that, in contrast to earlier debates which evolved around what one meant by the term 'competition', current debates evolve mostly around how to empirically measure deviations from it.

Before Marshall (1890), classical economists did not understand and therefore, were not concerned with cost/price relationships and properties of equilibria as elements central to the competitive theory of their neoclassical successors (Hovenkamp, 1991). Rivalrous behavior or oligopolistic interdependence, which is anti-competitive by modern neoclassical standards, was competitive in the classical view. Consumers were free to refuse to buy if prices were raised too high, just as businesses were free to set their prices. Monopoly pricing would always be undermined by potential competition.

After Marshall, the term competition took on a more technical meaning, no longer referring to rivalry between particular firms in particular industries. Now it became a hypothetical market structure comprised of abstract, indivisible firms making abstract output and price decisions in such a manner that rivalry was ruled out by definition (Dilorenzo and High, 1988). More significantly, the ideal against which industries must be judged is the theoretical, static construct of perfect competition. So, whether

market power studies today are of the SCP or NEIO persuasion, they still share the common objective of measuring departures of industries from such ideal by taking a snapshot of industry equilibria at a given point in time. In this sense, competition is viewed as a state of affairs within a well defined market. The process through which the industry reached its position at that point in time, including strategies to redefine the competitive environment, is outside the conceptual bounds of the empirical models. In other words, history does not matter!

Then one must ask of what use are mainstream empirical models to understanding the competitive process in the industry and informing competition policy? The unsympathetic view, usually held by historians of industrial organization, is that such models are of no use. Mainstream industrial economics, by focusing on adaptive rather innovative response to technological constraints, tends to look at business enterprises as nothing more than extractors of monopoly rents (Lazonick, 1991; Chandler, 1990). The sympathetic view is that the competitive process is captured by the effect of structural variables on intra-industry differences in, say, profitability or other measures of performance. This in essence was the approach taken by the much-maligned SCP cross-industry studies. The approach taken by their single industry successors makes the argument for capturing the competitive process through static modeling even less compelling. Performance in single industry studies is no longer something to be directly measured and explained by observable structural measures. Rather, it is an object of statistical inference.

The view I take in this article is that, after comparing how competition *looks* from the vantage points of mainstream studies of market power in the industry with how it *looks* from the vantage points of the industry's 300-yr business history, mainstream studies are more useful for a competition policy targeting conduct rather than structure. To support this view, I first provide in Section 2 a brief summary of underlying theory, practice, and findings of SCP and NEIO studies of competition in the meatpacking industry, After that, I trace the historical events that have shaped and have been shaped by the structure of the meatpacking industry since the colonial period. Section 4 closes with a discussion and implications.

2. The static theory and empirical evidence

2.1. SCP studies

As was mentioned earlier, some empirical studies of market power in the US meatpacking industry were conducted along SCP lines, others were based on more recent methods from of what has become known as NEIO. The hallmark of the SCP approach in general is the use of reduced-form regression models relating various alternative measures of market performance, such as output prices or price–cost margins, to structural and other industry characteristics, with seller concentration being the key variable. [2] A finding of a significantly positive concentration coefficient means concentration facilitates implicit or explicit collusion among firms, resulting in oligopoly power. The original SCP models were estimated using data from cross-sections of industries. The standard cross-section SCP regression looks something like this:

$$\Pi = \beta_0 + \beta_1 \cdot H + \sum_{i=2}^{k} \beta_i \, z_i + \epsilon \qquad (1)$$

where Π is some measure of profitability, H is a measure of concentration, the z_i's are other control variables believed to affect the dependent variable, β's are parameters to be estimated and ϵ is an error term. Observations correspond to different industries or temporally and/or spatially separated markets in the same industry. The center of attention in Eq. (1) is the estimate of the parameter β_1. A positive and significant β_1 signals market power. The positive link between concentration and non-competitive conduct is a maintained hypothesis. As shown by Cowling (1976) and Cowling and Waterson (1976), the relationship in Eq. (1) is implied by the first-order condition for profit-maximizing firms who hold Cournot-type conjectures about the response of their rivals' outputs to the change in their own output.

Cross-section industry studies had an effect on antitrust policy in the late 1960s. The celebrated monopoly suits against IBM and the ready-to-eat

breakfast cereal industry were brought during the heyday of SCP influence and the call for deconcentration in the 1969 Neal Report was apparently influenced by empirical SCP findings (Salinger, 1990). The major policy influence of SCP studies soon made them a visible target for dissent. A series of arguments arose over interpretation of profitability–concentration correlations and concerning various biases allegedly associated with measurement of structural parameters.

First and foremost among the dissenters was Demsetz (1973), who argued that firms become large because they are efficient. Larger size and larger profits both result from superior performance originating in greater managerial skills and innovativeness leading to superior products or reduced costs. Larger profits, by this view, lead to larger firms, implying joint determination of profits and concentration. Formal and more convincing support for Demsetz's hypothesis would come 10 years later from a theoretical paper by Clarke and Davies (1984).

Dissent against inter-industry profit–concentration regressions prompted examinations of the relationship between prices and concentration instead (Weiss, 1989). Prices are compared across geographically separated markets within a single industry. The intuitive idea of such comparisons is that a positive statistical correlation between output price and seller concentration is evidence of oligopoly power. The procedure is an extension of the SCP view that competition is inversely related to market share. Price–concentration studies are believed to offer a way out of the gridlock over whether market power or efficiency is responsible for positive correlations between profits and concentration, and, since they deal with single industries in geographically separated markets, the bias from omitting market-specific characteristics is minimized.

Most of the SCP studies of market power in the US meatpacking industry are of the price–concentration sort. Because the potential for market power being exerted is generally agreed to be greatest on the buying side of the market, virtually all the studies have analyzed oligopsony power in livestock procurement markets. The regression model often used the livestock market-price as their relevant performance index. The key explanatory variable is buyer concentration. The studies sometimes use variations

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[2] Readers interested in more detailed treatment of SCP studies are referred to the work of Schmalensee (1989).

of buyer concentration such as the number of bidders in an auction market, number of bids received at a given feedlot, or number of plants owned by a firm, as their explanatory variable. They also use variations of performance indices such as marketing margins, profits, productivity, or prices at the transaction level. Table 1 lists the studies along with their authors, data frequency, data type, observation unit, sample period and verdict regarding presence or absence of market power.

From the vantage point of SCP models, there is a strong negative correlation between concentration in beefpacking and cattle prices, especially so in studies using more recent data and from cattle supply areas or units that do not correspond to political boundaries. Structural impacts were either weak or inconclusive where national data were used, but negative and statistically strong between regional beefpacker

concentration and average regional fed cattle prices. The estimated concentration effects were about 14 cents/cwt for a 10% increase in concentration. Effects in one study were not significant until a 60–65% concentration level was reached. Price–concentration correlation was also significant at the transaction level. The largest three buyers paid between 17 and 26 cents/cwt less than the fringe buyers.

Effects of structure on market performance, in studies using national data, were inconclusive in porkpacking. However, the relation between regional porkpacker concentration and average regional hog prices was negative and statistically strong. Each 10% increase in concentration lowered prices about 14 cents/cwt. No definite relation between plant closings and hog prices was found. Lambpacking has received relatively limited coverage. Evidence of market power in lambpacking remains inconclusive.

Table 1
Summary results of SCP concentration–performance studies of US meatpacking, by study characteristics and livestock species

Type of study	Author(s)	Data frequency	Data type	Observation unit	Sample period	Findings for:		
						Beef	Pork	Lamb
Price Spreads								
Wholesale–retail	Hall et al. (1979)	A	CT	regional	1967–1973	+		
Wholesale–retail	Multop and Helmuth (1980)	Q	T	national	1967–1978	+		
Farm-wholesale	Ward (1988)	A	T	national	1972–1985	−	0	
Profits	Ward (1988)	A	T	national	1974–1985	0	0	
Prices								
Aggregate prices	Multop and Helmuth (1980)	A	T	national	1969–1978	−		
	Quail et al. (1986)	A	CT	regional	1971–1980	+		
	Marion and Geithman (1995)	A	CT	regional	1971–1986	+		
	Heyneman (1992)	A	CT	regional	1977–1989		+	
	Menkhaus et al. (1981)	A	C	state	1972,1977	+		
	Miller and Harris (1981)	A	CT	state	1972–1985		+	
Transaction price	Ward (1981)	D	CT	feedlot	July 1979	+0		
	Ward (1982)	D	CT	feedlot	July 1979	+		
	Ward (1992)	D	CT	feedlot	June 1989	+		
	Ward (1984)	E	T	auction	1979–1982			+0
Entry/exit	Love and Shuffett (1965)	W	T	local market	1959–61		+	
	Dobbins (1973)	W	T	local market	1969–1972		−	
	Hayenga et al. (1986)	W	T	local market	1972–1983		−	
	Ward (1983)	W	T	local market	1981		+	
Plant ownership	Hayenga and O'Brien (1992)	A	C	state	1973–1987		−	

Data Frequency; A = annual; Q = quarterly; W = weekly; D = daily; E = occurrence of sale.
Data type; C = cross-section; CT = cross-section time; T = time series.
Finding; + = evidence of market power; − = no evidence of market power; 0 = Inconclusive evidence

Table 2
Summary results of NEIO studies of US meatpacking, by study characteristics and livestock species

Type of study	Authors	Data frequency	Data type	Observation unit	Sample period	Findings for:		
						Cattle/beef	Hogs/pork	Total meat
Oligopsony / oligopoly	Schroeter (1988)	A	T	N	1951–1983	+L, +W		
	Azzam et al. (1989)	Q	T	N	1972–1986		+L, +W(72–78)	
	Azzam and Pagoulatos (1990)	A	T	N	1959–1982			+L, +W
	Schroeter and Azzam (1991)	Q	T	N	1972–1988		−L, −W	
	Azzam (1992)	M	T	N	1988–1991	+L, −W		
	Schroeter and Azzam (1990)	Q	T	N	1976–1986	+L, +R	+L, +R	
Oligopsony								
Market Power/efficiency	Azzam (1997a)	A	T	N	1970–1992	+L		
Switching conduct	Azzam and Park (1993)	A	T	N	1955–1987	−L(55–77)+L(78–87)		
Trigger price	Koontz et al. (1993)	M	T	R	1980–1982, 1984–1986	+L		
Trigger price	Weliwita and Azzam (1996)	Q	T	N	1978–1993	−L, +R		
APC pricing	Stiegert et al. (1993)	Q	T	N	1972–1986	+L		
Multiple markets	Koontz and Garcia (1997)	D	CT	R	1980–1986	+L		
Oligopoly	Holloway (1991)	A	T	N	1955–1983	−R	−R	
Bilateral oligopoly	Azzam (1996b)	Q	T	N	1970–1990	+L, +BO, +R		

Data frequency; A = annual; Q = quarterly; M = monthly; W = weekly; D = daily; E = occurrence of sale.

Data type; C = cross-section; C = cross-section time; T = time series.

Observation unit; N = national; R = regional.

Finding; + = evidence of market power; − = no evidence of market power; L = livestock market; W = wholesale market; R = retail market; BO = bilateral market power.

2.2. NEIO studies

Although NEIO and SCP studies have the same premise, i.e., oligopoly market power or departures from the neoclassical perspective of competition can be measured by the gap between output price and marginal cost (or, for oligopsony, the difference between factor prices and marginal value product), the two differ in modeling pricing conduct. [3] Pricing conduct is never explicit in SCP studies. Collusive behavior is accordingly thought to be reflected in significant positive correlations between structure and some measure of performance. Such implicit treatment of conduct presupposes that one subscribes to the idea that structure affects performance through conduct. The idea is attractive intuitively, but unsatisfactory on theoretical grounds.

In contrast, NEIO studies take the gap between prices and their shadow values as an unknown parameter to be estimated from observable prices and outputs. In other words, they ask what type of conduct is consistent with the observed equilibrium prices and quantities. A NEIO model, typical of those used in market studies of meatpacking, attempts to estimate the aggregate first-order condition, or supply relation

$$p = \frac{\theta}{\eta} p + c + e$$

where θ is a weighted average of the individual firms' conjectural elasticities, c is industry marginal cost, and e is an error term. If marginal cost is allowed to vary across firms then c could be considered also as a weighted average of individual firm marginal costs (Appelbaum, 1982). The ratio in the first term on the right-hand side of the equation is another expression for the price–cost margin, otherwise known as the index of market power or gap between price and marginal cost. By specifying a cost function, an explicit expression for c is appended. Share equations and a demand equation are usually added to construct a structural econometric model with cross-equation restrictions. The structural model gives empirical estimates of θ and η. This provides an (average) indirect estimate of the price–cost margin, and bypasses the measurement problem of constructing a price–cost margin from published data on prices and costs as is done traditionally. A particularly useful feature of NEIO models is their applicability to a variety of structure and conduct settings. As shown in Table 2, they have been applied to test oligopoly, oligopsony, or a combination thereof using a variety of oligopoly theories.

From the vantage point of NEIO studies, the evidential balance from time series studies using national data appears to weigh in favor of the hypothesis that meatpacker conduct in single and multiple live cattle markets is not competitive. However, the apparent degree of market power did not increase with increasing concentration. Results from a study using regional data showed beefpackers were unable to sustain effective cooperation. Their cattle buying alternated between cooperative and non-cooperative pricing conduct. Cattle price impacts of increased concentration were found to be small. Using a trigger price model with quarterly data, the hypothesis that packers maintain cooperative strategy was also rejected. High regional cattle supply elasticities may have been the cause. The market between packers and retailers may be characterized by a bilateral oligopoly, where the degree of dominance is shared equally between packers and retailers. Porkpacking has received relatively less research coverage than beef, but the evidential balance appears to weigh in favor of price-taking behavior, especially when the output price risk is incorporated in the analysis.

3. The business history

According to Clemen (1923), the earliest reference to meatpacking as a commercial enterprise in America dates to William Pynchon of Springfield, MA. There, in 1662, he set out to supply packed pork to plantations in the West Indies which, because of the Civil War in England (1640–1660), were cut off from English and Irish supplies of meat. Beef and mutton were rarely packed since, unlike pork, they did not preserve well. Moreover, cattle and sheep

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[3] For a thorough discussion of NEIO studies, see the work of Bresnahan (1989).

could be driven long distances, year around, to be slaughtered for fresh meat without major losses from shrinkage or deterioration in quality.

As settlers advanced westward across the mountains, the Ohio Valley became the center of the nations's livestock industry. Historians attribute the growth of cattle and hog production in the Valley in part to the Internal Revenue Act of 1794 which levied an excise tax on whiskey. No longer able to convert their corn efficiently into whiskey, farmers fed it instead to cattle and hogs. Surplus meat moved south to markets as far as New Orleans by flatboats and keelboats on the Ohio–Mississippi River systems. River towns sprung up as local points of contact with down-river markets. Farmers lacking river access drove their herds east across the mountains for slaughter in Philadelphia, New York, or Baltimore, or sold them as stockers to farmers along the way (Yeager, 1981). Still, by some accounts (Walsh, 1978), meat trade was limited by a shortage of salt. Commercial meatpacking remained a small-scale enterprise in the hands of small merchants who packed farm-killed pork or that from hogs driven by farmers to local markets.

Meat packing as a distinct and significant industry would not appear in the Valley until the late 1820s. According to Yeager, a major factor contributing to the evolution of the industry was the innovation of the upriver steamboat. This gave the region access to imported salt from the south, facilitating increased commercial packing and trade. Improved river transportation had much more impact on the packing of pork than of beef (Leavitt, 1934). The steamboat was better suited for carrying cured pork and provisions than bulkier, lower-valued live animals.

The first slaughterhouse west of the mountains opened in Cincinnati in 1818 (Hill, 1923). Located on the Ohio River, a tributary of the Mississippi, and the largest population center in the West before the Civil War, the city became the steamboat and commercial porkpacking capital of the world. Cincinnati pioneered in the manufacture and marketing of meat by-products which became sufficiently valuable that packers offered sufficiently higher premiums to compete for hogs from other valley locations. Higher hog prices and lower meatpacking wages kept slaughter volume in the city ahead of that of its major rivals in Madison and Louisville, KY (Leavitt, 1931). By

1854, the 26 packing houses in the city slaughtered more than one fourth of all hogs in the west.

Despite the appreciable growth of the industry, its characteristics were largely unchanged from those of colonial times. Slaughter, packing and marketing were for the most part separate activities. Hog carcasses were delivered by wagon from slaughter houses to packing plants where they were disassembled, trimmed, preserved and crammed in barrels for pickling. Until the invention of artificial refrigeration in the 1880s, packing houses operated only during the months of December and January, and then only when temperatures were not so cold as to hamper the cutting operations. The Ohio River and its tributaries were ideal locations for packing houses as winter temperatures in the area usually stayed above freezing. Reliance on natural refrigeration meant more economies were gained from greater speed than from larger size in accommodating accelerated product flows during the fresh winter packing season. Thus, the number of packers grew along with the volume of output. Between 1844 and 1855, the number of firms increased from 26 to 42, while output expanded from 240,000 to 424,000 hogs per year (Yeager, 1981). The short duration of the packing season also limited the potential for specialization. The main source of labor was local farmers who worked in packing plants during idle winter months. Meat marketing and distribution was dominated by commission merchants who engaged in various other lines of business besides meat packing. [4]

Although the first stretch of US railroad was built in 1830, it was not until 20 years later that the new mode of transport began to have profound effects on the growth and location of livestock production and meat packing (Skaggs, 1986). By 1855, most farmers east of the Mississippi River and north of the Ohio had access to railroad lines (Leavitt, 1934). The landlocked producers in those regions who previously relied on drovers to market their livestock now had a faster, more dependable and less expensive means of land transport. As reported by Leavitt,

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[4] Only 41% of meatpacking industry value added in the 1850s came from factories with steam- or water-powered methods of production. About 32% came from artisans (1–6 employees), 11% from sweatshops (7–25 employees), and 15% from manufactories (over 25 employees). See the work of Atack (1985).

railroad charges for hauling cattle were as much as 50% lower than driving costs. This led to higher net prices for farmers and to dramatic increases in livestock production. The locus of cattle raising also shifted westward to the prairies of Illinois and Missouri where the ratio of cattle to rural population was twice that in other Middle Western states.

By widening the area feasible for the production of livestock and speeding their shipment to the East, railroads fostered competition between eastern and western packers. By the late 1850s, about a fifth of all the hogs marketed in the West were shipped outside the region (Walsh, 1977). No comparable figure is available for cattle, but records of western animals shipped to the New York City cattle market indicate that 67% of total receipts were from the West (Leavitt, 1934). The building of the railroads also made it more economical for porkpacking to move further west, closer to the source of supply. However, since fresh meat must be consumed soon after slaughter, the West remained locationally disadvantaged for the slaughter and shipment of fresh meat to distant markets until the invention of artificial refrigeration.

While the replacement of the drover by the railroad did increase both the speed and volume of livestock shipments, it did not totally resolve the shrinkage problem. Western cattle shipped to the East Coast lost about 10% of their initial tissue weight (much of it in the first 200 miles) and suffered from overheating, bruising, smothering, freezing, and disease (Aduddell and Cain, 1973). To reduce these losses, railroads invested in feeding stations and stockyards, thus creating new catalysts for locational change in the meatpacking industry. The most important change was the emergence of Chicago as the transshipment center for western cattle on their way east, a development that positioned it for its later emergence as the nation's foremost center of meatpacking. Having become a hub for the interchange of eastern and western railroads by the 1850s, Chicago offered an alternative to the southern Mississippi route as an exit for western produce in general.

The closing of the Mississippi route during the Civil War cemented Chicago's pre-eminence in transshipment as well as packing of livestock. The increase in livestock shipments, fueled to a significant extent by military demand during the war, overloaded the city's capacity to handle the traffic, leading in 1865 to the establishment of the famous Union Stockyards, which would remain in operation until 1970.

As much as both the Civil War and railroads contributed to the rise of Chicago as an important meatpacking center, the packing business, prior to mechanical refrigeration, was still '' ... in the hands of those butchers who slaughtered in or near the community where the meat was to be consumed ... Faster transportation could make but little difference, but regardless of the speed of the train the meat would spoil before it could be transported any great distance if mechanical refrigeration were not provided.'' (US Federal Trade Commission, 1919).

Experimentation with mechanical refrigeration dates to the early 1850s when the first American patents were awarded for the production of artificial ice. However, it was not until 1867 and 1868 that the first refrigerator-car patents were issued. George Hammond, emerging packing giant, is credited with the first shipment of fresh meat to the East, shipping dressed beef in 1869 to Boston from his slaughter plant near Chicago (Skaggs, 1986). To avoid direct contact with ice, which discolored the meat, carcasses were initially hung from the roof. However, ''in rounding curves the meat was set in motion like a pendulum and started the car rocking; ... [this] caused a number of wrecks and as result the railways objected to the use of the cars and they were discontinued'' (Hill, 1923). Refrigerator-car technology would remain plagued with problems until the arrival of another future packer mogul, Gustavus Swift.

Swift, a cattle buyer from Massachusetts, moved in 1874 to Chicago where he took up his old trade. He soon recognized the superior cost efficiency of shipping dressed meat rather than live animals from Chicago to the East, and the critical need for an efficient system to distribute the perishable product (Kujovich, 1970).

Swift saw the waste in paying freight on the inedible 45% of the animal in order to move the remaining 55% to market. Not satisfied with the technology of the refrigerator-cars he used in making his first shipments from his packing plant in Chicago in 1877, he and engineer Andrew J. Chase invented and patented in 1879 what would become the stan-

dard for refrigerator-car efficiency (Skaggs, 1986). In 1881, Swift began establishing branch houses as transshipment points for fresh meat originating from his Chicago plants. Moving to counteract Swift's expansion, Armour, an already established trader in preserved meats, along with Hammond and Morris, all established branch houses in the East. By 1888, Swift, Armour, Hammond and Morris accounted for about 89% of the cattle slaughtered in Chicago and produced two thirds of the nation's dressed beef supply (Yeager, 1981). The four also owned slaughter and packing facilities in a number of other Midwestern cities. Employment in the industry rose from 8366 in 1870 to more 60,000 by the end of the century (Skaggs, 1986). [5]

Aduddell and Cain (1973) identified three sources of scale economies in the meatpacking industry of the late 1800s: ownership of a centralized distribution system, division of labor and utilization of animal by-products. By owning their own refrigerator cars and branch houses, packers eliminated the need for brokers. Marketing became more efficient since meat could be moved from areas of excess supply to those with excess demand. The wider market and year-around production afforded by the introduction of refrigerated rail cars meant plants need not now be built to the large capacity formerly required to meet seasonal demand. [6] Larger volume slaughter also led to by-product economies; large packers were adept at finding uses for these materials, purchasing even more from smaller packers, and using their own distribution systems to promote their by-products [7] (Aduddell and Cain, 1981a,b).

Internal economies were also believed by Aduddell and Cain (1973) to be significant but not as important in explaining the growth of concentration in the industry as packer ownership of refrigerator cars and control of the country's most important stockyards. By moving large volumes of dressed meat in their own cars, the large packers were able to obtain favorable mileage allowances and better service. The initial mileage allowance was $3/4$ of a cent $mile^{-1}$ car^{-1} for east-bound traffic from Chicago, 1 cent for west-bound traffic. Average daily miles traveled by cars owned by the large packers were twice those of other freight cars.

The refrigerator car also made it more economical to slaughter near the source of supply. As further enticement for packers to locate west of Chicago, cities in the Midwest, including Omaha, St. Louis, KS, and Saint Paul, offered packers securities in the stockyards located in those cities.

Along with exploitation of economies in production, distribution and transportation came lower meat prices, increasing consumption, and (initially) higher cattle prices. Per capita consumption of beef rose from an average of 77.8 lb during the 1870s to 87.2 lb during the 1880s. Cattle prices declined through most of the 1870s, but rose to unprecedented levels in 1884. Higher cattle prices led to larger cattle numbers, 70% more by 1890 than 15 years earlier. Larger numbers meant larger marketings, 152% more in the Chicago market in 1890 than 10 years earlier. The boom went bust by 1885. Cattle prices declined from a peak of US$25.56 per head in 1884 to US$16.49 in 1891, a 35% nominal decline, 24% in real terms (Libecap, 1992). The downturn in prices plus the inability of local butchers and slaughterhouses to compete with lower priced fresh beef from the major packers raised widespread concern. Libecap (1992, p. 244) recounts how ''Local slaughterhouses charged that the Chicago packers used diseased cattle and that dressed beef was unwholesome. One remedy, urged especially by midwestern cattle raisers, was federal meat inspection to promote demand.'' At the same time, ''... they feared market power of the Chicago packers, [and] believed that the Chicago packers were responsible for the severe fall in cattle prices after 1885.''

In response to demand for legislation, the US Senate in 1888 adopted a resolution to appoint five

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[5] By 1910, half of the work force were immigrants from Eastern Europe, and about 20% were native-born. By 1920, 15% of the workers in the industry were African Americans, many often were initially employed as strikebreakers (Stanley, 1994).

[6] In an empirical study of structural change in American manufacturing during the 1850–1890 period, James (1993) concluded that concentration in meat packing may have been more the result of economies in marketing and distribution than of economies of scale from production.

[7] By-products were manufactured into finished products such as soap, lard, candles, sausage casings, glue, brushes, combs, and buttons (Lesser, 1993). The US margarine industry owes its beginnings to the US meatpacking industry which produced large quantities of the raw material in the form of animal fats (Sutton, 1991).

senators "… to examine fully all questions touching the meat products of the United States; and especially as to transportation of beef and beef cattle and the sale of same in the cattle markets, stockyards, and cities; and whether there exists or has existed any combination of any kind, either on the part of… transportation agencies, or on the part of those engaged in buying and shipping meat products, by reason of which the prices of beef and beef cattle have been so controlled, or affected as to diminish the price paid the producer without lessening the cost of meat to the consumer" (Quoted in Clemen, 1923, p. 748). Thus, began the first governmental investigation of meat packers. The investigation lasted 2 years and resulted in what is known as the *Vest Report*. The report charged that the 'Big Four,' Armour, Hammond, Morris, and Swift, colluded to fix beef prices, divide territories and business, divide the public contract business, and compel retailers not to buy from packers outside the Allerton Pool (Aduddell and Cain, 1981a,b). The 'pool' evolved from an 1886 agreement involving the Big Four and Samuel Allerton, another Chicago packer, and resulted in the regulation of meat shipments and stabilization of prices, especially in the saturated Northeastern beef market. Nonetheless, the *Vest Report* resulted in no actions against the packers. Its findings, however, probably influenced the passage of the Sherman Act in 1890.

The pooling arrangement was soon undermined by the entry of the Cudahy in the meatpacking business in 1890. Cudahy's competitive strategy was to select the West as a marketing target rather than the East, where the 'Big Four' had strong presence. Plants and branch houses were built in Los Angeles, Sioux City, Omaha, Lincoln and Minneapolis and a fleet of 90 refrigerator cars was acquired by 1892 (Yeager, 1981). A price war among the now 'Big Five' led to the abandonment of the pool in May 1892.

Fierce price competition following the dissolution of the pool brought near financial ruin to some packers, especially as the 1893 depression shrunk the demand for meat. Armour, Morris, Swift, and Hammond tightened customer credit; Swift slashed wages; and Armour bought gold to settle wages (Yeager, 1981). Another pool was formed and expanded to include the Cudahy. Each of the Big Five was as-

signed a territory and allotted a volume of business based on market share from the previous year. Attorney Henry Veeder was put in charge of compiling the statistics and levying penalties on cheaters. The new pooling arrangement, or what became known as the *Veeder Pool*, operated until 1902 except for a 1-yr disruption starting at the middle of 1896. The disruption resulted from the entry of a new firm, Schwartzchild and Sulzberger (S&S). S&S, a New York-based packer in the Kosher trade, realized that in order to compete with Western packers who tapped Eastern consumer markets, it had to expand to reach Western livestock markets. In 1893, the new firm purchased a packing company in Kansas City, built branch houses nationally, and purchased a fleet of refrigerator cars. The Big Five faced a dilemma. "If they shipped their allotted volume into the areas where S&S competed, they flooded the market and were forced to sell beef at such a low price that there was little or no return on investment. On the other hand, if they attempted to cut back shipments, S&S might increase its shipments" (Yeager, 1981, p. 124). Attempts by the pool to recruit S&S into membership were unsuccessful and the pool was suspended in May, 1896.

In response to S&S's refusal to join, two of the former pool members, Swift and Armour, initiated pressure tactics. According to Yeager, 1981 (pp. 124–125), "Swift spearheaded a drive to enlist the help of other pool members in establishing a kosher beef house in New York to compete with S&S… [Armour] tried to apply indirect pressure on S&S by wooing the Santa Fe Railroad, the main carrier of S&S business out of Kansas City." By 1898, S&S became a pool member. The pool resumed and operations continued until 1902 when the US Attorney General filed suit seeking an injunction under the Sherman Act against the packers. The charge was conspiracy to restrain interstate commerce.

To evade the charge of collusion, the three largest packers in 1903 opted for a merger. Armour, Morris and Swift formed the National Packing (NPC) as a holding company. The new company included Hammond and four other small firms. Its personnel, largely officers from the parent companies, held weekly board meetings. Consequently, NPC became "a central post to disseminate information and 'dressed' costs, closing prices, and margins," and a

price leader for the two excluded packers, Cudahy and S&S (Chandler, 1977, p. 400). With the formation of NPC, the packing giants or 'Beef Trust,' as they had collectively become commonly known, extended from coast to coast.

The year 1903 also marked the beginning of a long and protracted series of investigations which would end 17 years later in a consent decree between the major packers and the Department of Justice (Packer Consent Decree, 1924-1925). The impetus for the investigation came from two sources. First was President Theodore Roosevelt, who had as a goal when he took office in 1901 the protection of the public from exploitation by the trusts. "To him trusts, were less an economic than a political, social and moral problem... and [he] singled out for condemnation... those which in his own judgement, engaged in unfair competitive practices" (Yeager, 1981 p. 185). Congress responded to the president by creating the Bureau of Corporations in 1903. The second source was the precipitous drop in cattle prices following an unprecedented high in the previous year, and an abnormally high price of beef. Responding to the demand from cattlemen for legislation, the House of Representatives passed a 1904 resolution requesting "... the Secretary of Commerce and Labor [to] investigate the causes of the low prices of beef cattle, and the unusually large margins between the prices of beef cattle and selling prices of fresh beef" (Quoted in Walker, 1906, p. 495). A year later, the Bureau issued what became known as the *Garfield Report*, after the commissioner of the Bureau. This report provided the first official data on concentration in the industry. Of the total slaughter in the country, the big packers accounted for 45%. Their share was 97.7% in the West (Walker). The Bureau also concluded that, because of variations in the prices of hides and fats, the spread between the price of beef and the price of cattle was not a reliable indicator of industry performance. However, because the 1902 injunction against the packers was still before the courts, the report was devoid of any mention of monopolization or restraint of trade. The Bureau's favorable judgement of the industry was not well received by the public. Muckraker Charles Edward Russell (1905, p. 5) described the National Packing as "Reaching out, absorbing industry after industry, augmenting and building, by

great brute strength and insidious, intricate, hardly discoverable windings and turnings, day and night monstrous thing flows and strengthens until its grip is at the Nations' throat."

Less than a month after the Bureau's report, another indictment was brought against the packers in Chicago for violating the Sherman Act. Eventually, the defendants were declared immune from criminal prosecution, since they had already cooperated with the Bureau's investigation. In 1910, criminal antitrust action was taken against NPC. The government charged that during the 9 years of its operations, NPC had engaged in price fixing and maintained livestock pools which, according to a 1905 Supreme Court decree on combinations, were illegal. The jury acquitted the packers in 1912. The packers, however, dissolved the company 2 years prior to the verdict. Chandler (1990) believes the company was no longer needed because by then the packers had learned much about each other's internal operations and tacit collusion would now substitute for overt measures.

When livestock prices slumped in 1915, despite an increase in exports and a decline in imports, feeders demanded an explanation. [8] In response, a resolution to investigate the meat industry was introduced in Congress in 1916 by representatives from Missouri and Kansas. The resolution was amended a year later to put the investigation in the hands of the Department of Agriculture. Troubled by the amendment, representatives from cattle states called on President Woodrow Wilson to direct the Federal Trade Commission to make the investigation. The President did so in February 1917 and the FTC released its report in July, 1918. As summarized by Arnould (1971, p. 24), "Evidence was found of: (1)

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[8] The United States has been the major world exporter of meats since the 1870s with England as the major market. The US position was lost between 1900 and 1911 when domestic demand was so strong that there was no longer surplus fresh meat for the export market. In fact, cattle were admitted duty free to the US in 1913 as cattle feeders were unable to supply sufficient beef cattle for urban markets. In response, US packers purchased plants in Argentina, Uruguay and Brazil to process beef for the European Market and, by 1913, the US market as well. See Skaggs (1983) (p. 135); Chandler (1990, p. 401); and Virtue (1920).

international allocation of sales in conjunction with the amount of space available on steamships; (2) a rotational process of local price cutting to eliminate small firms; (3) a division of purchases at leading terminal markets, awarding fixed percentages to each of the member companies; (4) an agreement to control meat prices; and (5) the use of branch house facilities to control substitute foods."

Following the report, FTC commissioners called for public ownership through the Wartime Railroad Administration [9] of the packers' transportation and distribution network. Congress held a series of hearings on bills calling for measures similar to those requested by the FTC commissioners. According to Virtue (1920, p. 680), the hearing may have been the product of "... the war psychology of the period, when no proposal for an extension of government activities seemed too extravagant." The war notwithstanding, the bills failed to pass. Instead, the Department of Justice initiated Antitrust action against the Big Five, Armour, Cudahy, Morris, Swift, and Wilson. [10] Realizing the seriousness of the charges, the Big Five agreed in 1920 to the signing of a consent degree with the US Attorney General. The decree required the packers to divest themselves of public stockyards, interests in railroads and terminals, market newspapers, cold storage warehouses, retail meat businesses, and stock adding to 50% or more in any corporation or business dealing with commodities unrelated to meat (Packer Consent Decree, 1924-1925, p. 107). In 1921, Congress enacted the Packers and Stockyards Act. The Act established a code of fair trade practices in the purchase of livestock and sale of meat, regulated the business practices of all stockyards and created an administrative unit within the Department of Agriculture to enforce these provisions.

Although the consent decree and the creation of the Packers and Stockyards Act marked the beginning of a new period for the industry, some believe that neither policy had any significant, immediate or direct impact on the meatpacking industry. The Big Four, Swift, Armour, Cudahy, and Wilson, [11] maintained their shares in cattle and hog slaughter until the 1930s, increased their shares in slaughter of calves and sheep and engaged in market-sharing in livestock markets. [12]

What may have had a direct impact on the industry were the reduced barriers to entry occasioned by rapid developments in transportation and refrigeration technology, in-plant technology, the rise of the supermarket, increasing labor costs and the federal grading system (Arnould, 1971). With the introduction of the motor carrier and the construction of a nationwide highway system, meatpackers were freed from dependence on railroads, reducing the need for terminal stockyards and plants owned by the larger packers and located by railheads in large cities (Stanley, 1994). Improved refrigeration techniques allowed the development of low-cost mechanically-chilled trucks, reducing capital requirements for entry into the business of meat distribution. By 1946, two-thirds of the 100,000 meat-handling trucks on the road were mechanically-chilled, and one-third of the total were owned by independent transport firms (Skaggs, 1983). The developments in transportation technology altered the competitive advantage of transporting fresh meat by rail. According to Maki et al. (1962), between 1930 and 1956, transportation costs changed such that it became economical to ship fresh and processed meats by refrigerated trucks from packing houses west of Chicago. That, along with lower wages, cheaper land and new sources of fed cattle in the Western corn belt and Southern Plains, gave rise to independent packers in the rural Midwest, Southwest and Far West.

With the emergence of retail chain stores, the branch houses, which served smaller independent grocery retailers and local meat markets, became redundant. The new corporate chains relied instead on independent meat wholesalers or carlot packers to stock their meat shelves. The introduction of the

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[9] The United States entered World War I while the FTC inquiry was in progress.

[10] S&S, after a sale of its stocks in 1915 to a group of bankers, was renamed Wilson and Company after its president Thomas Wilson.

[11] Morris was acquired by a subsidiary of Armour in 1923.

[12] Although the leading packers may have engaged in market sharing at terminals, they never integrated into cattle production (Livesay and Porter, 1969).

federal grading system during World War II also helped bring down barriers to entry into the industry and may have put the big packers at a disadvantage. Unlike their smaller competitors, the big packers had large sums of capital tied to brand names and private labels. In addition, improved in-plant refrigeration and slaughter technology, such as stunners, powered rails, mechanical knives and hide pullers, power saws, made single-story plants more practical and efficient than multistory, multispecies packing plants, making specialization in one species or even classes within species possible (Nicholls, 1940). [13]

By 1960 most of the plants in Chicago were idle, and by 1970 the Chicago Stockyards had closed. Besides lower land prices and proximity to feedlots, lower wages in 'right to work states' attracted many urban packers to the Midwest. [14] The closing marked the end of an era during which the guiding economic principle was that it was more efficient to slaughter cattle near their source and to ship carcasses rather than live animals to eastern markets. Interestingly, the new era in meatpacking, which started in the 1960s, is a further extension of the principle, that it is even more efficient to ship cattle as 'boxed beef' than to ship carcasses to wholesalers and retailers. The traditional function of the beefpacker had changed very little prior to the fundamental realignments of the 1960s. Animals were slaughtered and carcasses were shipped to 'breakers' who disassembled the carcasses into primal cuts. Virtually no processing of the carcass of any sort took place at the slaughter stage. But increasing labor costs, emerging technologies and new specialized demands by hotels, restaurants, institutional buyers, and variously situated retail stores combined to make the process of shipping whole carcasses from the pack-

ing plant increasingly outmoded (US Congress, 1980).

In the revised system, beef carcasses are broken, boned and cut in primals and sub-primals, and individual cuts vacuum packed in plastic and shipped in boxes. Iowa Beef Processors (IBP), founded in 1961, gets much of the credit for pioneering large-scale boxed-beef production, building the first plant for that purpose in 1967 in Dakota City, NE. [15] The process resulted in significant economies from labor specialization and substitution of capital for labor in large-scale disassembly operations. Soon, other firms joined the boxed-beef bandwagon. None, however, would grow as fast as IBP which, by the 1970s, became the leader in beef-packing, a position it continues to enjoy. [16]

IBP's quick rise to the top raised concerns over possible abuses of market power. In 1970, the company entered into a consent decree requiring it to halt for 10 years further acquisitions of packing plants in its four-state area of operations. Special congressional hearings were held in the late 1970s, directly focusing on the packing company and its alleged misconduct in the boxed-beef market (US Congress, 1979a,b).

The rise of IBP during the 1970s, was concurrent with the integration of major old-line packers into large conglomerates (IBP was itself bought in 1981 by Occidental Petroleum, remaining an Occidental subsidiary until 1991). Wilson (Schwarschild and Sulzberger in the 19th century), founded in 1916, changed its name to Wilson Foods in 1976 after being acquired by Ling–Temco–Vought (LTV). Armour became part of Greyhound in 1970. Swift became a subsidiary of the Esmark conglomerate. Cudahy was acquired by General Hosts. Excel, another old-line, if less visible packer, would later play a prominent role following the industry shakeout in the 1980s. Founded in Chicago as Excel Packing in 1936, it merged in 1969 with the Kansas Packing

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[13] Owing to these developments, Cudahy, Armour and Swift asked a federal court in 1956 for relief from the Consent Decree, arguing that business conditions during the 1920s were no longer the same in the 1950s. The request was denied. See the works of Aduddell and Cain (1981a,b). Aduddell and Cain reported 12 antitrust suits were filed against the packers between the signing of the Consent Decree and 1956.

[14] After World War II, labor wages in many meatpacking firms were the set through a series of master agreements signed with unions.

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[15] Armour, however, initiated the concept of boxed beef in the mid 1950s (US Congress, 1979a,US Congress, 1979a, p. 8).

[16] IBP's cost-cutting strategies also included locating plants far from heavily unionized areas. This has resulted in a dramatic restructuring of the labor force which is now heavily composed of immigrants and refugees (Stanley, 1994).

and three other smaller firms to form the Kansas Beef Industries (KBI) and marketed boxed beef under the label XL. In 1974, KBI merged with Missouri Beef Packers, creating MBPXL.

The decline in the production and consumption of red meats as a group and of beef in particular in the late 1970s left the industry with excess slaughter capacity. The excess capacity, by making consolidation a more attractive means of growth than building new capacity, triggered a wave of mergers and acquisitions starting in 1977 and continuing as of this writing. The result, was a drastically and, to some, an alarmingly changed industry structure for the slaughter of cattle, hogs and sheep.

The top four spots in beefpacking in 1977 were occupied by IBP, Swift, MBPXL, and Spencer. Together they held about 30% of total beef slaughter capacity (IBP 13, Swift 6.9, MBPXL 4.9, and Spencer 4.3%) (Marion and Kim, 1991). By 1982, the top four had 4% of industry capacity. IBP led with 20.9%. Excel, (MPBXL before its acquisition by Cargill in 1979) followed with 12.1%, SIPCO (Swift Independent Packing, Swift in 1977) had 6.3%, and Spencer 5.6%. ConAgra entered the beef slaughter industry in 1983 in a major way by acquiring, among many other firms, SIPCO and Monfort. By 1988, Conagra edged Excel to become the second largest beefpacker with 21.1% of industry capacity. IBP remained first with 27%, Excel was third with 17.1%, and Beef America fourth with 4.5%. As of 1996, the top three companies were still in the lead.

Although the packaging technology of boxed beef has found its way into porkpacking as well, it has been less important in influencing the structure of the industry than in beef. Integrated slaughter and processing involving small as well as large firms has been characteristic of porkpacking for decades (Crom, 1988). Smaller porkpackers do not rely on larger packers for further processing as do smaller beefpackers, some of the latter having become dependent on boxers to sell their products at retail (US Congress, 1990a,b). By the early 1980s, Wilson (one of the early line packers) was still the largest porkpacker in the industry. It, along with Swift Independent, Morrell and Hormel, accounted for 37% of federally inspected slaughter in 1984 (Hayenga and Kimle, 1992). According to Hayenga and Kimle, that percentage had changed marginally by 1992 to 42.4%

of total slaughter capacity, but in the meantime the largest beefpackers, IBP, ConAgra and Excel, had joined the ranks of the largest porkpackers. Through a combination of acquisition, renovation and building of new plants IBP had moved to the first spot in hog slaughter, holding by 1990 about 12.5% of total industry capacity. ConAgra moved into the pork slaughter business when it acquired plants from Swift, Armour, and Monfort. ConAgra ranked second behind IBP in 1990, its total share of industry capacity being 11.2%. The third-leading packer, John Morrell (a subsidiary of Chiquita brands), had a 6.2% market share. Excel (the Cargill subsidiary) has also acquired two plants in the Midwest and ranks number four with a market share of 5.7%.

Lamb slaughter has historically been the most concentrated of the red meats. The four-firm concentration ratio reached a high of 68% in 1930, a figure not surpassed until 1987, after acquisitions of some large lamb slaughter plants by some of the large packers during the foregoing decade of acquisitions. A case in point is ConAgra; when it acquired Armour, Swift, and Monfort, it also acquired their lamb slaughter plants, which were some of the largest in the business. By 1987, ConAgra, Denver Lamb/Iowa Lamb, Farmstead, and Superior Lamb together accounted for 75% of all lamb slaughter in the United States (Ward, 1989), the highest concentration since 1909.

Another development in the meatpacking industry arousing concern among producers and policy makers is a trend toward backward vertical integration and coordination (US Congress, 1990b). This recent trend contrasts with that at the heyday of the old packers at the turn of the century, when forward integration into transportation and branch houses for wholesale distribution was commonplace.

PS & A reported that in 1995 the proportion of the top four packers' steer and heifer slaughter accounted four by 'captive supplies' is about 21%, 4% packer-fed and the rest acquired through forward contracts and marketing agreements. In a survey of 19 porkpacking firms, Hayenga et al. (1996) found that 13% of the hogs slaughtered were acquired through long term contracts (11%) and through facilities singly or jointly owned by packers (2%). Lamb feeding by packers has historically been much higher than for cattle and hogs. PS & A data indicate that the

proportion of lamb slaughter by the three lamb pack-
ers reporting accounted for by packer-fed lambs was
23% in 1995. [17]

Again, reminiscent of reactions to the 'Beef trust'
environment a century ago, the current environment
in the industry has spawned what a recent report on
concentration on agriculture has characterized as "a
breeding ground for distrust and suspicion." (US
Department of Agriculture, 1996, p. 5). Interestingly,
the report was the result of dissatisfaction with find-
ings of a much larger study of concentration in the
red meat packing industry commissioned by Congress
in 1992. The verdict of the study, published in the
1996 report *Concentration in the Red Meat Packing
Industry*, is that "quick answers to complex market
structure and behavior issues are not available. Steady
sustained monitoring and analysis provide the best
opportunity to obtain, meaningful information as the
industry evolves and market conditions change" (p.
x). With no deconcentration in the industry in sight,
one should expect more investigations to look for an
answer to the same perennial question: Does a highly
concentrated industry exert market power? And if it
does, what should be done about it?

4. Discussion

The empirical literature outlined in Section 2
represents one way of assessing competition when
taking a snapshot of industry equilibria at a point in
time. The assessment is ahistorical in that it offers
little understanding how the industry reached such
equilibria, or whether in fact, the economic data used
for assessing competition represent realizations of
equilibria. The literature's philosophical point of de-
parture is that 'the firm' in the industry has well-de-
fined objective (profit maximization) and seeks to do

as well as it can to optimize its objective given the
constraints of technology. The benchmark against
which the firm is judged is competitive conduct
which, by SCP standards, is measured by the rela-
tionship between structure and performance or, by
NEIO standards, is measured by the gap between the
price of meat its marginal cost and/or between the
price livestock and its marginal value product net of
marginal processing cost.

Abstracting from data problems and interpreta-
tional difficulties which plague both SCP and NEIO
studies, the evidential balance weighs in favor of
(statistically) significant, though small departure from
competitive conduct. The implication is that both
consumer and producer welfare could be increased
by steering packer behavior toward closer conform-
ity with the perfectly competitive benchmark. [18] The
question is whether one should target the structure or
conduct of the industry.

A structure policy runs head on with the issue of
tradeoffs between market power and static and dy-
namic efficiency from concentration. Empirical work
regarding the tradeoff between static efficiency and
market power has recently been published in two
studies of the beefpacking segment of the industry.
The first study, by Azzam and Schroeter (1995),
used an oligopsony analogue of Williamson's trade-
off model to find out whether the cost reductions
achieved through economies of plant size or multi-
plant operation offset allocative inefficiency result-
ing from deterioration packer market conduct.

The trade-off model is illustrated graphically in
Fig. 1. The national market consumer demand curve
for beef is labeled D and S is the national market
cattle supply curve. Assuming constant marginal pro-
cessing costs, packers' derived demand for cattle is
DD. With an initial (pre-consolidation) distortion of
D, initial cattle/beef quantity and cattle price are Q
and $\hat{w}$ and initial beef price is $\hat{p}$. Now suppose that
(perhaps over a period of several years) the industry
undergoes a drastic reconfiguration involving consol-
idation of production in fewer, more efficient plants
and heightened market power. The improvement in
cost efficiency shifts the derived demand to DD*.

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[17] Empirical work on the effect of captive supplies on prices
received by independent livestock producers is not as extensive as
that dealing with effects of packer concentration in slaughter.
Whatever exists, however, is still carried along SCP lines, where
livestock prices are simply regressed on the proportion of slaugh-
ter accounted for by captive supplies (Ward et al., 1996). For a
study along NEIO lines see the works of Azzam (1996a). For a
critique of studies of captive supplies using the SCP framework,
see the works of Azzam (1997b) (forthcoming).

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[18] Provided of course the administrative 'steering' costs do not
exceed the benefits to society from enhanced competitive conduct.
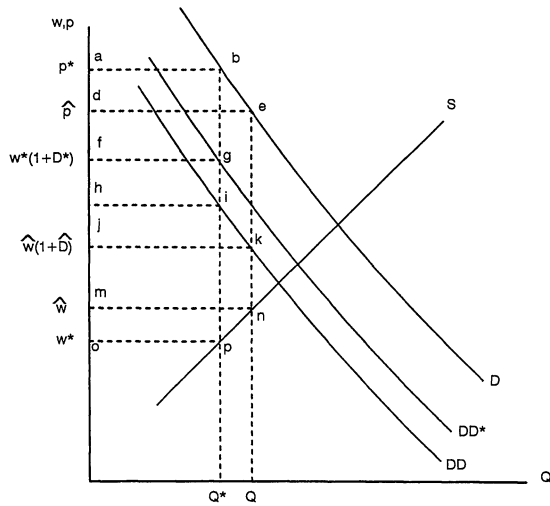
Fig. 1. The national markets for cattle and beef.

Marginal processing cost is now lower so the vertical distance between consumer demand for beef and packers' derived demand for cattle is now smaller. Greater market power is reflected in a larger distortion: D^* as opposed to D. Post-consolidation quantity, cattle price and beef price are now Q^*, w^*, and p^*, respectively.

The welfare effects are also represented in the diagram. The loss in consumer surplus is area 'abed', loss in cattle producer surplus is 'mnpo', and gain in packers' variable profit is area 'fgpo' minus area 'jknm'. Adding these components gives the total welfare effect: area 'fgih' minus the additional deadweight loss associated with the further oligopsony curtailment of output, area 'iknp'.

Calibration of the model requires an initial estimate of D. For this, Azzam and Schroeter relied heavily on the cost analysis of beef packing plants conducted by Duewer and Nelson (1991). Once calibrated, the oligopsony model was used to project the effects of changes in concentration or conduct. For a variety of such hypothetical changes, the authors solved for the proportionate reduction in marginal processing cost that would be consistent with no net change in overall welfare; that is, the cost reduction that would render the sizes of areas 'fgih' and 'iknp' equal. The Duewer and Nelson (1991) cost estimates suggest that the marginal cost reduction that would actually be achieved through a 50% increase in

average plant size is more on the order of 4%. This calculation suggests that the recent trend toward consolidation in beef packing, even assuming that it has been accompanied by heightened market power, may well have been welfare-enhancing on balance.

A more recent paper by Azzam (1997a) set out to address the same issue by developing a testable rather than a calibrated simulation model as in the work of Azzam and Schroeter. Starting with the first-order condition of a profit-maximizing oligopsonistic firm, assuming a quadratic Generalized Leontief processing cost function, and aggregating across firms in the industry, Azzam derives the estimating equation

$$M = \frac{H(1 + \Theta)}{\eta} + \Sigma\Sigma\alpha_{ij}\frac{\left(v_iv_j\right)^{1/2}}{w} + 2HQ\Sigma\beta_i\frac{v_i}{w}$$

where the dependent variable $M = (p - w)/w$ is the percentage farm-wholesale beef margin, with p and w being the wholesale-beef price and the cattle farm price, respectively; H is the Herfindahl index of beefpacking concentration (proxied by the four-firm concentration ratio); Θ is a weighted average of the firms' conjectural variations derived in manner similar to Cowling and Waterson; the v_i's are prices of inputs other than cattle; Q is beef output; η is the price elasticity of cattle supply, which along the cost function parameters (the α's and β's) are to be estimated using industry level data. Differentiation of the estimating equation with respect to H yields the derivative

$$\frac{(1 + \Theta)}{\eta} + 2Q\Sigma\beta_i\frac{v_i}{w}$$

where the first component is the market power component and the second is the cost efficiency component. [19] The point estimate of Θ was -0.799 with a standard error of 0.125. Both Cournot-type and price-taking behavior were rejected for the industry. Evaluation of the two effects at the sample mean values of prices and quantities yielded 0.238 for the market power effect of concentration with a standard error of 0.077, -0.446 for the cost-efficiency effect

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[19] The hypothesis that conduct (Θ) is independent of structure (H) was not rejected.

with a standard error of 0.103, implying a total effect of −0.208. Apparently, during the sample period used (1970–1992), the cost-efficiency effect of concentration of the farm-wholesale beef margin were twice the market power effect. This suggests that a double dividend of lower cost and higher cattle prices from surgically lowering industry concentration is unlikely.

Comparable empirical evidence on the tradeoff between market power and dynamic efficiency [20] for the industry is not available. However, there are reasons to believe that taking measures to reduce attainment and exercise of market power by industries in general may come at the expense of such dynamic efficiency (Baumol and Ordover, 1992). The public-goods character of research and development is one reason, although it may not be as important for the beef packing industry [21] as scale economies in the use of product and process innovations, and the sunk costs incurred in making the innovations operational.

The trace of historical events that have brought commercial meatpacking from the obscurity of William Pynchon's modest 17th century enterprise to the industrial giants that dominate the industry today suggests patterns of process and product innovations ranging from ice rooms, refrigerated rail cars, transformation of by-products into finished products adopted a century ago to boxed beef technology today. It also suggests patterns of concentration, location, and scale of enterprise to support such innovations. From this historical vantage point, the competitive process in the industry consists of a series of what business historians characterize as innovative rather than adaptive responses to constraints, the type asserted by neoclassical economic theory (Lazonick, 1991). In this sense, concentrated meat markets in which prices are found to diverge from their perfectly competitive levels may be im-

perfectly competitive in the neoclassical environment of price competition, but dynamically competitive in the Schumpetarian environment in which industries experience a 'perennial gale of creative destruction.' In the Schumpeterian environment, profits are the returns to the innovative activity necessary to maintain a dynamically competitive process, and competition is not price competition—the hallmark of traditional price theory—but competition in innovation (Dasgupta and Stiglitz, 1980). Where the latter is important, imperfect competition in the product market is necessary and, consequently, the analysis of competitive equilibrium within the Arrow–Debreu framework is of limited applicability (p. 27).

The implications for a structure policy are clear. Where competition in innovation naturally leads to winners and losers, it would be a mistake to surgically intervene to maintain an industry configuration consistent which the static notion of competitive conduct in the product market. In this sense, empirical static departures of product or factor prices from the competitive norm, such as those established by SCP and NEIO models, are not informative for a structure policy. Where they may be useful is in informing conduct policy, especially on the degree of implicit coordination whereby competing firms may be able 'to coordinate their pricing without conspiring in the usual sense of the term—that is without any overt or detectable acts of communication.' (Posner, 1976). In this case, the challenge is to devise creative measures, in the form of marketing institutions, to dissipate the rents from implicit collusion. Where acts of communication are overt and detectable, as was the case in the beef cartel at the close of the last century, Antitrust remedies come into play. [22] And, it would be quite a leap of faith to infer those acts from the (econometric) apparent collusion that would have had to occur to generate the price–concentration relationship in SCP models, or equilibrium industry prices and quantities in NEIO models.

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[20] Dynamic efficiency consists of the Pareto–Optimal allocation of resources between present and future (Baumol and Ordover, 1992).

[21] Or for the whole food manufacturing industries, for that matter. In fact, ''most inventions and innovations affecting efficiency originate outside the food manufacturing industries.'' Marion and the NC117 Committee (1986).

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[22] As surprising as it may seem, formation of a cartel does not always lead to price-fixing, as some industries may be more 'structurally predisposed' to fix prices than others (Dick, 1997).

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