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Changing Structure and Competition in Food and Agricultural Markets

Joseph Balagtas

The U.S. Departments of Justice and Agriculture (DOJ, USDA) have signaled a renewed interest in the competitiveness of food and agricultural markets, and have organized a series of public workshops held across the country to stimulate discussion of the economic and legal issues. A main concern is whether producers are harmed by ongoing changes in the structure of agricultural and food markets, including consolidation in farm inputs, processing, and food retailing, as well as increased coordination along the vertical supply chain. As Secretary of Agriculture Vilsack put it in his opening statements to the workshop held in Iowa in March of this year, "…the central question is, are the farmers and ranchers of this country currently getting a fair shake?"

The agricultural economics profession is in a unique position to inform this discussion, building on a vibrant body of economic research and in-depth knowledge of important institutions. The set of papers in this theme draws on these resources to explore some of the economic aspects of competition in agricultural and food markets. The papers are organized to address these issues in markets where the DOJ/USDA have focused their interest: seed markets, livestock markets, dairy markets, and food retailing.

In the first paper on the biotech seed industry, Kyle Stiegert, Guanming Shi, and Jean Paul Chavas summarize work from a series of studies that examines pricing of biotech seed. A first finding is that bundling—combining multiple biotech traits in a single seed—tends to lower

the price of the traits to the farmer, suggesting that economic efficiencies associated with concentration may attenuate the effects of market power. However, they also find evidence that vertical integration—production of biotech traits and germplasm under the control of a single firm—tends to raise seed prices relative to licensing agreements, raising concern that recent acquisitions that have lead to vertical integration are enhancing the market power of biotech firms at the expense of farmers. GianCarlo Moschini notes that the dominant positions of certain firms in the market for biotech traits arise from intellectual property rights (IPR) in the form of patents, and that IPR protection is necessary to induce technological innovation that benefits society. Thus, in this case, IPR law is at odds with antitrust law, and the line between legitimate exercise of IPR rights and antitrust violations is a blurry one.

Two papers on livestock markets review key structural changes that have taken place and discuss the implications for market performance. Clem Ward reviews the recent changes in the structure of the beef packing industry: a dramatic shift towards larger and fewer plants, as well as larger and fewer firms, and a shift away from cash market transactions in favor of forward contracts and other alternative marketing arrangements. Ward notes that these changes have been driven at least in part by economic efficiencies, a fact borne out by a large body of research. Of course, these changes also raise concerns of potential market power, but Ward points out that the agricultural economic research on this score is mixed; a typical finding is that beef packing is characterized by but either oligopsony—a few dominant buyers—or oligopoly—a few dominant sellers—pricing, but that the departure from perfectly competitive pricing is small. John Lawrence reviews similar changes in the structure of hog markets, including increased size of hog farms, increased concentration in packing, and a move towards alternative marketing agreements. Lawrence highlights results of a recent study that finds that while pork packers

exercise some degree of oligopsony power, alternative marketing agreements do not appear to be a contributing factor. Indeed, economic efficiencies associated with marketing contracts may benefit both producers and consumers. Thus, recent proposals to limit use of marketing contracts in hog procurement may be counterproductive.

Two articles on the dairy sector highlight the role of government regulations in dairy pricing. Brian Gould documents the growing concentration among dairy farms, dairy cooperatives, and dairy manufacturers, and then goes on to describe how particular marketing order regulations and conventions in dairy pricing may facilitate the exercise of market power. Many regulated and contract prices rely on wholesale prices determined in thinly traded markets for dairy commodities. Thus large cooperatives or private manufacturers may influence regulated farm prices via strategic trades in wholesale markets. Haley Chouinard, David Davis, Jeffrey LaFrance, and Jeffrey Perloff find a more direct effect of marketing orders on market performance. They use their estimates of retail demand for dairy products to calculate the impact of price discrimination—the practice, enforced by marketing orders, of setting a higher price for milk used in fluid products—on dairy consumers. They conclude that marketing order regulations are regressive, harming those consumers who can least afford to pay.

Finally, two articles turn our attention to competition in food retailing. Rich Sexton argues that while the emergence of large, dominant grocery retailers probably has been beneficial for consumers, it probably has not been so for producers. Moreover, Sexton warns that models of perfect competition as well as traditional models of imperfect competition are inadequate to capture observed patterns in retail food prices. Tim Richards and Geoffrey Pofahl list many of the features of grocery retail markets that are relevant to competition, and report on their results from analysis that attempts to capture some of this richness. Among other insights, they find that

market power increases in the number of products offered, and also that grocery retailers may use private labels to wrest pricing power from food manufacturers.

Taken together the papers in this *Choices* theme highlight some of the important economic issues at the heart of competition in U.S. agricultural and food markets. The papers also highlight the insights that the agricultural economics profession has to offer on this pressing public policy issue. In many cases, the authors raise more questions than they provide answers, which may be unsatisfying to those looking for a quick solution to a preconceived notion of a problem. But full appreciation of the scope of the problem is a prerequisite for sound economic policy.

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Innovation, Integration, and the Biotechnology Revolution in U.S. Seed Markets

Kyle W. Stiegert, Guanming Shi, and Jean Paul Chavas
JEL Classifications: L11, L13, L25

The importance of seeds dates back at least ten thousand years to the rise of agriculture. Indeed, the origin of agriculture is associated with the selection and planting of seeds that eventually contributed to large increases in food production. Over the last century, advances in breeding and hybrid seed development and the rise of modern genetics have put the selection of seeds on a firm scientific basis. Advances in biotechnology have enabled the production of genetically modified (GM) crops with specific, desirable traits not found in their parents. The first generation and most common GM traits generate either resistance against one or more insects, or tolerance to specific chemical herbicides. Emerging GM traits address a broader array of consumer and producer market demands including nutrition enhancement, drought tolerance, and protection from plant disease. While the use of GM technology remains controversial in some countries, the rapidly advancing biotechnology seed industry has contributed to improved agricultural productivity and had a major impact on the production, delivery, and pricing of agricultural seeds and other inputs in the United States and around the world. These current and emerging changes are likely to reshape much of the global agricultural production system in ways that generate both excitement and caution.

In this article, we discuss the major trends and our key research findings on the pricing, trait bundling, efficiency, and the potential effects of market power in the U.S. seed industry. The

research, documented in six detailed reports (Shi, Chavas and Stiegert, 2009, 2010a, 2010b; Shi and Chavas, 2010; Shi, Stiegert, and Chavas, 2010; and Stiegert, Shi, and Chavas, 2010), utilizes nationwide farm survey databases collected in the United States by Dmrkynetic Inc. The data cover annual farm-level purchases and prices of corn, soybean, and cotton seeds from 2000 to 2007. The data allow the documentation of several key and important characteristics in the evolution, pricing, and industrial structure of the seed industry. The research provides empirical results on seed markets that relate to trait bundling and bundle pricing, product differentiation, and price discrimination.

Discussion of the Industry

GM crops were commercially produced beginning in the mid-1990s. From 1996-2008, production of GM crops grew from 4.2 million acres in six countries to 309 million acres in 25 countries (James, 2008). GM production is primarily concentrated in six countries (United States, Argentina, Brazil, India, Canada, and China) that planted about 95% of the global GM cropland (James, 2008). Before 2000, early development of commercially viable GM seeds incorporated only a single genetic trait, specifically an insect-resistance trait for cotton and corn, and a herbicide-tolerance trait for soybeans. The development and rapid adoption of double, triple, and quadruple stacked GM seeds with multiple genetic traits primarily occurred since 2000.

Government regulations, farm demand, and consumer demand affect the adoption and spread of GM technology in agriculture. GM seed development is a multi-year process involving many test trials conducted by biotechnology firms and leading to commercializing a handful of selected varieties. Biotechnology advances essentially piggyback on conventional breeding selection that supplies viable seeds to farmers. The commercial value of GM

technology is suggested through the price premiums paid by farmers for GM seeds compared to the price of conventionally bred seeds. We document several of the key strategies employed by seed and biotech firms to price seeds in ways that both spur adoption and capture some of the economic benefits generated by advances in GM technology.

Research and development (R&D) expenditures on new and patentable genetic traits and seeds are an important part of the production cost of seeds. Over the last few decades, private sector R&D expenditures in agriculture have increased sharply, as applications of new biotechnologies have become associated with exclusive property rights for genetic traits. This has contributed to an increase in seed prices (Krull, Prescott, and Chum, 1998). However, the institutional arrangements for how R&D costs translate to seed prices vary across crops. The development of hybrid corn has a long history of private sector involvement primarily because hybrid vigor is not maintained in seeds from the previous year's harvest. Cottonseeds have also been developed primarily through private sector R&D. Corn and cottonseed pricing is structured to pass R&D costs on to farmers. In contrast, hard wheat seed R&D is conducted predominantly in the public sector and funded by upfront investments through commodity check-off programs. As a result, the prices of hard wheat seeds usually only reflect a small fraction of the total development costs. Soybean seed development has transitioned since the 1980s from large public R&D, much like hard wheat, to being almost fully privatized (see Heisey, Srinivasan and Thirtle (2001) for more a detailed discussion).

Over the last few decades, horizontal and vertical merger activities in the agricultural biotechnology and seed industries have contributed to the development of a concentrated and complex industry (Fernandez-Cornejo, 2004). The U.S. biotechnology seed industry has received extensive utility patent protection under American law since the 1980s. This patent protection

has effectively precluded antitrust oversight of the use of those rights despite the presence of high concentration in the GM seed markets. Biotechnology firms have also vertically integrated downstream to the seed industry while licensing patented traits to other seed companies that in turn offer GM seeds. In this setting, vertically integrated biotech-seed firms compete for seed sales against independent seed firms licensing the same traits. How and to what extent these licensing arrangements extend or limit competition is an emerging issue. This is illustrated in a patent infringement case (Monsanto v. DuPont) that focuses on contract terms that prohibit Monsanto's licensees from stacking its genes with other patent holders' traits (Kilman, 2009).

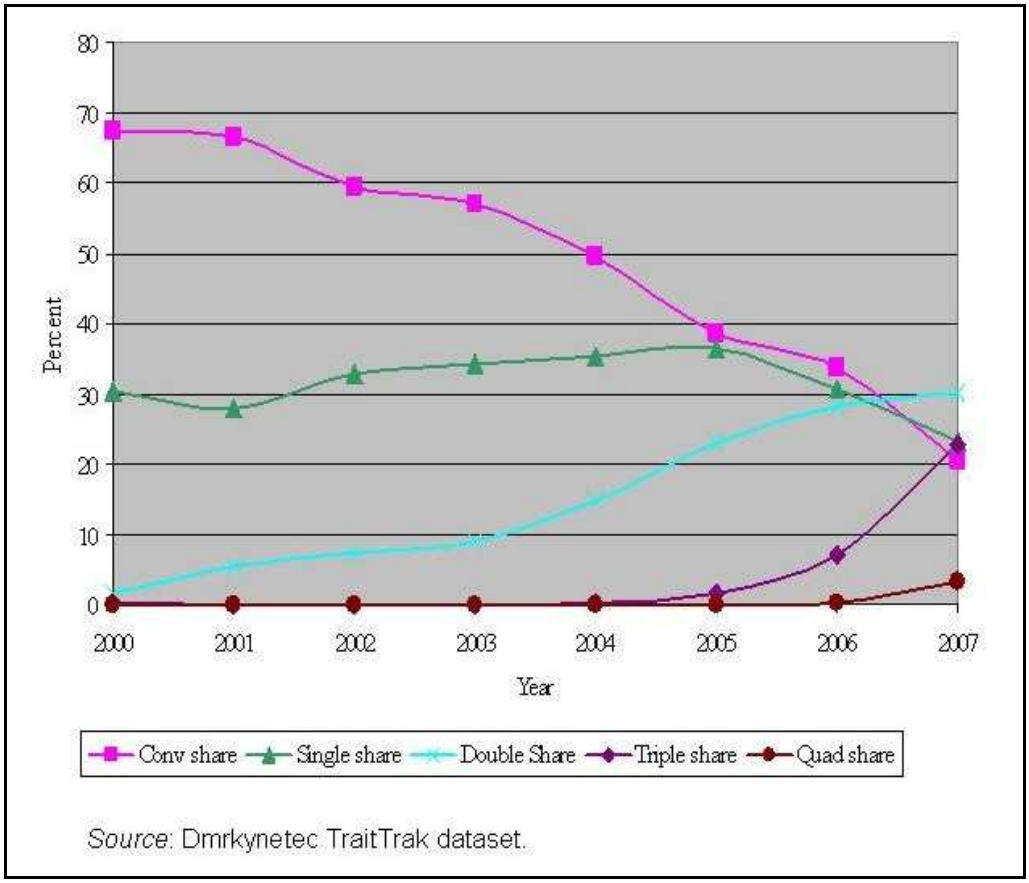

Figure 1. Percentage of U.S. Acreage Planted in Conventional and GM Corn Seed, 2000–2007.

In cotton, Syngenta has received permission to include the Monsanto *Bt* gene and a herbicide tolerance gene from Bayer Crop Science. This is due to an antitrust settlement in May 2007 that

imposed conditions on Monsanto's vertical acquisition of Delta Pine & Land to terminate all provisions in its cotton seed licenses that restrict trait stacking of genes from different sources.

The GM seed market has seen tremendous growth and change over the last decade. Using Dmrkynetic data, Figures 1-3 show the adoption rate of GM corn, soybean, and cotton seed, respectively. The acreage share of GM seeds is now over 80% for each of these crops. However, the growth patterns for single-trait and stacked GM seeds are strikingly different across crops. For corn, the rise in stacked seeds outpaced the adoption of single-trait seeds especially after 2005, while in soybeans, the single-trait seeds remain dominant over the whole time period.

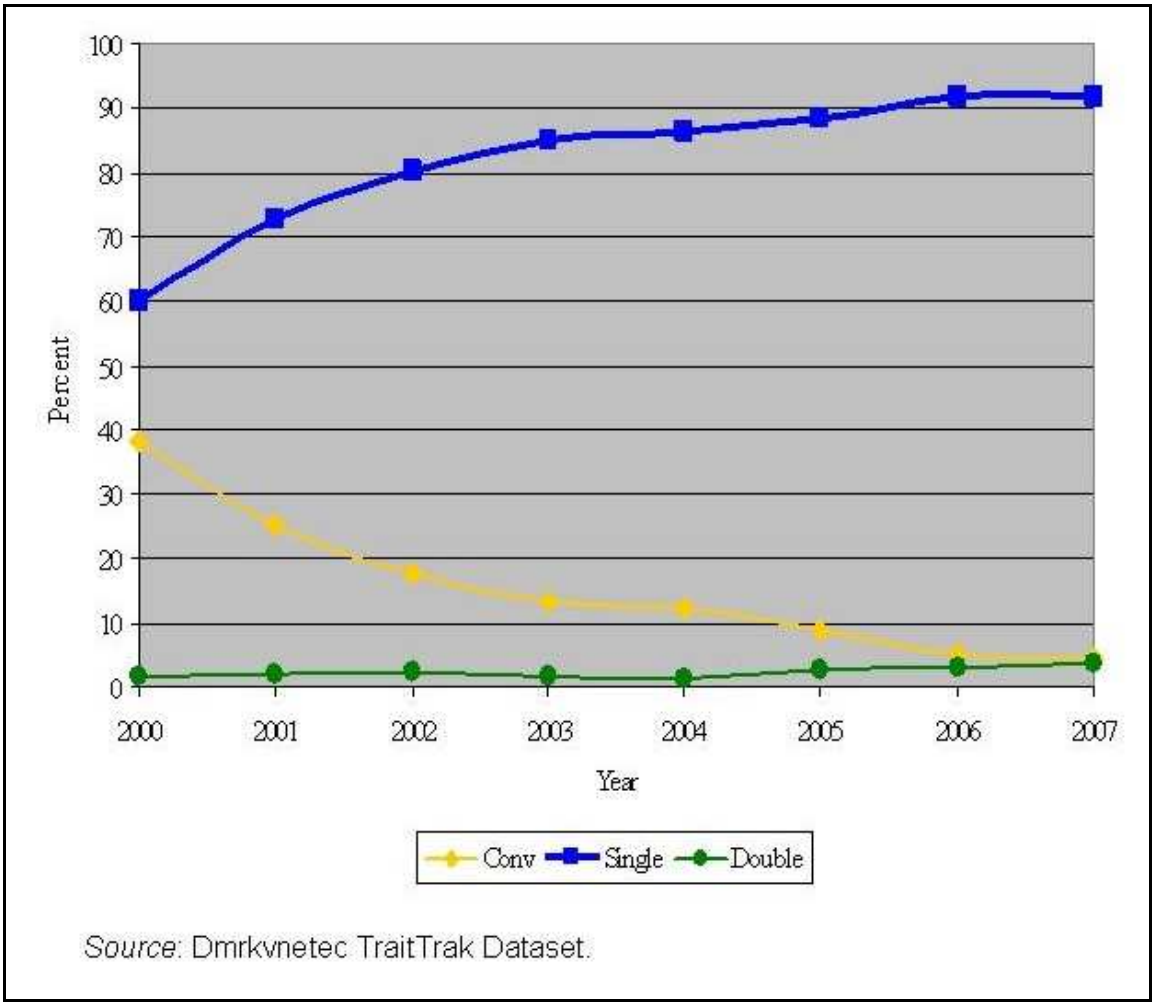

Figure 2. Percentage of U.S. Acreage Planted in Conventional and GM Soybean Seed, 2000–2007.

For cotton, stacked seeds have had a steadily increasing market share. We also note that stacking is most prolific in corn with a range of double to quadruple stacks while only double stacking in present in soybeans and cotton.

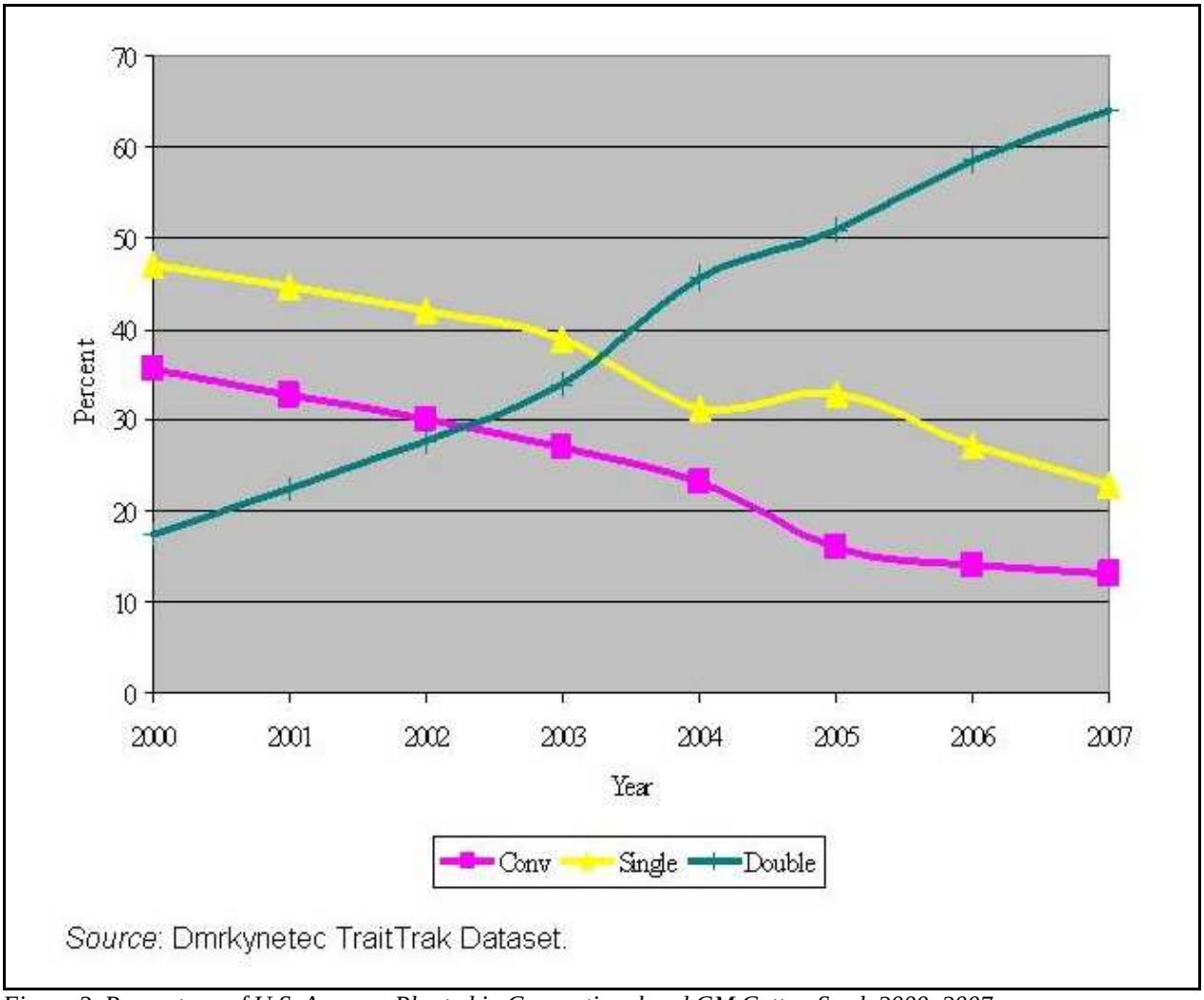

Figure 3. Percentage of U.S. Acreage Planted in Conventional and GM Cotton Seed, 2000–2007.

The market price of GM seeds reflects both the cost of producing the seeds and the farm benefits from using them. For a vertically integrated biotech-seed firm to remain viable in the long run, operating income—sales revenue less operating costs—must be sufficient to cover the fixed costs associated with seed and trait development, marketing and promotion costs, and the cost of financing. Meanwhile, seed prices must not exceed the farmers' net benefit from using the seed. Farmers have an incentive to use GM seed when it provides benefits from increased

farm productivity and reduced production cost that exceed the additional seed cost. Given the oligopolistic structure of the biotech-seed industry, several strategies can be employed by firms to lower their costs, extract economic benefits from farmers and seed dealers, and increase adoption of GM seeds. The findings from our research reported in the next three sections provide insights into these strategies.

Trait Bundling and Bundle Pricing

Seeds are sold at a list price less a discount available at the point of sale. GM seed prices vary with trait stacking/bundling, perceived agronomic conditions in each region—pest infestations, rainfall, etc.—availability of substitute seeds, commodity prices, and farmer income. For bundled biotechnology traits in the corn seed market, Shi, Chavas and Stiegert (2010a) rejected standard component pricing of biotech traits, where the price premium for multiple-stacked seeds would be equal to the sum of the price premium for relevant single-trait seeds. They found strong evidence of sub-additive bundle pricing, where the price of stacked seeds is sold at a discount compared to component pricing. Similar results were obtained by Shi and Chavas (2010) in their analysis of the soybean seed market, and by Shi, Stiegert and Chavas (2010) in the U.S. cottonseed market. This evidence is consistent with the presence of complementarity and economies of scope in the production of seeds with bundled traits. In general, sub-additive seed pricing is good for farmers who want to have access to multiple traits, since it reduces their access cost to these traits.

Using less aggregated data of the corn market, Shi, Chavas and Stiegert (2010b) and Stiegert, Shi, and Chavas (2010) uncovered a more varied price discrimination pattern. The former paper studied pricing at the biotechnology firm level, while the latter broke out the Corn Belt into two regions: the core and the fringe. In both studies, sub-additive pricing is most

commonly observed. However, there was also limited evidence of super-additive pricing, where the price of stacked seeds is sold at a premium compared to component pricing. Super-additive pricing may be associated with firms taking advantage of market power to extract economic gains from farmers. In Stiegert, Shi, and Chavas (2010), its occurrence appears closely tied to the herbicide-tolerance trait and only in the core region. In Shi, Chavas and Stiegert (2010b), super-additive pricing is found to be specific to the behavior of a single firm. Although limited in scope, the presence of super-additive pricing implies that different pricing patterns may emerge in ways that depend on specific market settings.

Conduct and Pricing in the U.S. Seed Industry

Seed prices may also depend on the increasing level of industrial concentration. Biotechnology firms can benefit from complementarities and economies of scope that enhance the efficiency of R&D activities related to genetic improvements across traits and/or crops. On the other hand, high concentration raises concerns about the exercise of market power, which could have adverse effects on the efficiency of R&D activities, the rate of technological progress in agriculture, and the rate of adoption of biotechnology.

To confront the issue of market concentration, we develop and employ a multi-product variant of the traditional Herfindahl-Hirschman index (HHI) as a measure of market concentration. These indices are called generalized HHI or GHHI. The GHHI recognizes traditional own-market concentration and extends the analysis to consider cross-market concentrations involving markets for different seed types. The cross-market GHHI is shown to have a positive relationship with price when the products are substitutes, but a negative relationship with price when products are complements. For example, complementarities can arise if a more integrated system of production of GM seeds by a few large firms contributes to

reducing the cost of development. If these complementarities are large, they can reduce or reverse the price-enhancing effect of market power. An econometric analysis of seed prices can provide useful information on how market concentration can affect seed prices. For corn, Shi, Chavas and Stiegert (2010a) and Stiegert, Shi, and Chavas (2010) found evidence of departures from marginal cost pricing, reflecting that market power does influence seed prices paid by farmers. For cotton, Shi, Stiegert and Chavas (2010) found that increases in own-market concentration do contribute to higher seed prices. But they also documented that, through complementarities, cross-concentration tends to be associated with lower seed prices. This shows that increased market concentrations do not always increase prices. It also stresses the need to analyze the implications of imperfect competition in a multi-market context.

Vertical Ownership and Pricing

Does vertical organization affect pricing in the U.S. seed sector? Shi and Chavas (2010) and Shi, Stiegert and Chavas (2010) study this issue for soybean and cotton, respectively. The analysis distinguishes between two types of vertical organizations: licensing and vertical integration.

The evolving vertical structure in the U.S. cottonseed industry is of special interest. While the licensing of biotechnology seeds remains dominant, biotechnology firms have increased their use of vertical control through integration. The market for integrated cottonseed has grown beginning in 2005 when Monsanto repurchased a previous spinoff (Stoneville) and expanded on its vertical integration afterwards. Bayer CropScience, a large agricultural biotechnology company, entered the cottonseed market in 1999 through the acquisition of FiberMax varieties from Aventis Crop Science, and has exhibited a major growth in sales since 2002 (Shi, 2009). And similar trends exist in the soybean seed markets. In single-trait soybean seed markets, vertical integration has increased from 13% of the market in 2000 to 26% in 2007.

This documents a general trend toward vertical integration in the U.S. seed sector. Are these changes motivated by efficiency gains that might reduce the prices paid by farmers? Or are they reflecting attempts to increase market power that raises the price? Shi and Chavas (2010) and Shi, Stiegert and Chavas (2010) found evidence that seed prices do vary with the vertical organization of the sector. For both soybean and cotton, they document that seed prices under vertical integration tend to be higher than under licensing. This indicates that vertical integration by biotechnology firms may increase the exercise of market power and the firms' ability to extract economic benefits from seed dealers and farmers. Such finding is consistent with biotechnology companies' reluctance to allow licensees to stack the licensed trait with other companies' trait, as exemplified by the antitrust settlement in the above mentioned Monsanto-DPL case. Biotech firms can recover the R&D expenditure more effectively through direct sale under vertical integration than through licensing fee revenue. Indeed, cheaper alternatives from the licensees may impose some competitive pressure to the integrated firms' product.

Final Thoughts

Biotechnology advances have been catalysts for innovations in agriculture, and they have been associated with a growth of private R&D investments, the patenting of GM traits, and increased concentration in seed markets. The rapid adoption of GM seeds in the United States gives an indication that biotechnology has contributed to strong agricultural productivity gains. So far, seed prices have been low enough to maintain farm profitability and induce farmers to adopt GM seeds.

Mergers have led to increased concentration in seed markets, and they are part of trend toward greater vertical integration in the biotechnology seed sector. The rapid emergence of only a few firms that hold most patents on GM traits is a public policy concern. These changes raise

questions about the organizational efficiency of the U.S. and global seed industries, which is important as seeds are crucial factors affecting the ability of agriculture to feed a growing world population. Will concentrated markets lead to higher seed prices, fewer choices for farmers and closure of independent seed companies? What market structure would maintain the incentive for private investments in seed development? While history has shown that the privatization of the seed industry can be consistent with rapid technological progress in agriculture, maintaining a balance between providing incentives for agricultural innovations and sustaining farm profitability remains a challenge. Our most consistent finding through all studies is a preponderance of sub-additive pricing in stacked seeds. We have also found that increased concentration in the seed industry has contributed to higher seed prices. However, through multimarket complementarity effects, increased concentration can also be associated with efficiency gains and lower seed prices. Future research should be directed toward a better understanding of these topics to provide policymakers with information on how to protect and expand innovations while maintaining a good distribution of associated benefits between innovators, farmers and consumers.

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Stiegert, K., G. Shi, and J.P. Chavas. 2010 Spatial Pricing of Genetically Modified Hybrid Corn Seeds in Genetically Modified Food and Global Welfare (Food System Research Group Working Paper FSRG2010-08

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Competition Issues in the Seed Industry and the Role of Intellectual Property

GianCarlo Moschini
JEL Classification: L1, L4, O3, Q1

The reawakened interest in competition issues in agricultural markets might appear to have found its ideal poster child in the seed industry. Concentration is high and market structure has shown remarkable dynamics over the last 15 years, with high-profile mergers and acquisitions by key players. A dominant firm—Monsanto—seems to have emerged, at least from the perspective of biotech traits perceived as essential in modern seed varieties. The two largest U.S. seed companies, DuPont and Monsanto, have embarked on a tough legal battle. And the Department of Justice (DOJ) has opened a formal antitrust investigation of Monsanto practices. Yet, despite its many motives of interest, the seed industry's competition issues are probably not representative of what matters in other agricultural markets. A distinctive feature in the seed industry is that innovation is crucial and heavily dependent on sizeable research and development (R&D) investments. Commitment to R&D by private firms, in turn, relies crucially on the existence and enforcement of intellectual property rights (IPRs), patents in particular. Strong IPRs necessarily confer limited monopoly positions. Whereas that is well understood and widely accepted as a reasonable method to promote the provision of innovation by the private sector, there remains an inherent tension between IPR and antitrust concerns in this industry.

IPRs and Seed Industry Innovation

Agricultural research can claim remarkable achievements over the last century, with impressive productivity gains that have ensured the availability of an abundant and safe food supply that meets the needs of a growing world population. Celebrated successes such as those underlying the Green Revolution owe much to public funds supporting research in public institutions. But the current structure of R&D is much more dependent on private investments. In the U.S. economy, industry R&D at present accounts for more than two-thirds of total R&D investments. More specifically, in agriculture, private R&D has exceeded public R&D expenditures since the early 1980s. To feed a growing world population, and to meet the competing demands on land from bioenergy, it is apparent that continued productivity growth is essential. Inasmuch as that depends on new and improved seed varieties, the heavy lifting will have to be done by private R&D investments, and the availability of secure, enforceable, and strong IPRs is, arguably, a necessity.

Knowledge is the quintessential public good—nonrival in consumption and, in and of itself, nonexcludable. Absent IPRs, it is clear that firms have little incentive to engage in expensive R&D that can create new and useful knowledge. Why undertake the costs of being an innovator if one can wait for others to do that and reap the same benefits by copying and imitation? The prospect of such destructive "free riding" behavior has long been acknowledged, and most developed economies have implemented strong legal measures to protect the rights of inventors. For plants, in the United States such measures include protection of trade secrets, the 1970 Plant Variety Protection (PVP) Act and—following the landmark U.S. Supreme Court decisions in *Diamond v. Chakrabarty* (1980) and *J.E.M. Ag Supply v. Pioneer* (2001)—utility patents. The latter provide the strongest protection and are now routinely used for biotechnology research tools, genetically modified (GM) traits, and traditional germplasm. Patents grant to the

innovator the right to exclude others, for a limited time period, from using the patented product or process. Such exclusionary rights can be a source of considerable returns if there is a strong demand for the innovation because it effectively allows the patent holder to behave as a monopolist. It is the prospect of such returns that provides the needed incentive for investment in R&D (Langinier and Moschini, 2002). Of course, this market solution to the problem of promoting innovation is second best in nature: once the innovation is available, the patent actually restricts its use and it is a source of (*ex post*) efficiency loss.

Seed companies need property rights to justify their substantial R&D investments. For example, the prospect of farmers saving a portion of their harvest to use as seed in the next period obviously reduces the ability of suppliers to recoup the cost of improved seeds over many growing seasons. Prior to the possibility of using patents to prevent that, it is not surprising that the crop that attracted most private R&D investments was maize—saving seeds does not work well with hybrid varieties. The development of a vibrant maize seed industry owes much to the natural property rights protection offered by the hybrid technology, over and above the remarkable discovery of the productivity effects of hybrid vigor. But patent protection is now available on many aspects of seed production, including GM traits and varieties, and that has tremendously enlarged the scope of profitable private R&D investments in the seed industry. Indeed, patents have been crucial to the commercialization of modern biotech varieties. Seed suppliers can market elite varieties, embedding herbicide and/or insect resistance traits, and charge a price premium, without the fear that others might misappropriate the product and compete unfairly in future periods or that farmers might save a portion of their harvest for replanting, thereby negating a market for the product for future periods.

Biotechnology and Industry Dynamics

The nature of innovation in the seed industry has been radically affected by the biotechnology revolution in agriculture, a development that has produced exciting innovations as well as some unexpected and unresolved problems (Moschini, 2008). Specifically, modern seed varieties of major crops, such as corn, soybeans, cotton, and canola, derive their value to users from two sources that are both essential: germplasm and GM traits. The latter, of course, refer to the traits engineered by insertion into plants of foreign genes—typically single genes, which may however be stacked—that confer a desirable attribute, such as herbicide tolerance or insect resistance. Germplasm refers to the sum total of all hereditary material in a plant, as coded in its DNA. For a crop, it reflects the compounding nature of sequential improvements carried out by breeders over a long period of time, all of which, of course, is encapsulated in the seed.

Not surprisingly, commercial breeders are keen on protecting the results of their efforts from misappropriation, and a complex set of IPRs has emerged to help them do so. The 1970 PVP Act allowed for the creation of patent-like "certificates" for new, distinct, uniform, and stable varieties. This *sui generis* IPR protection was developed at a time when it was believed that living organisms did not constitute patentable subject matter. But all that changed in 1980 with the landmark U.S. Supreme Court decision of *Diamond v. Chakrabarty*. It is important to understand that utility patents can now be used to assert germplasm ownership for traditionally bred varieties, and not just for GM traits. Other IPR protection instruments that are relevant to the seed industry include trade secrets—which have been effectively used for maize inbred lines in a few high-profile litigations—and material transfer agreements. Because patents provide a stronger protection than PVP certificates (Moschini and Yerokhin, 2007), breeders have started to favor their use. Some evidence in this respect is shown in Figure 1, which reports the number of PVP certificates and patents on varieties, issued over the 30-year period ending in 2009, for

both corn and soybeans. Specifically, such counts are reported as total for five-year periods, to smooth out year-to-year variations partly due to the vagaries of the approval process. It is clear that, in the most recent half of the period considered, the use of utility patents for plant varieties has increased considerably. In the last five years, in particular, the number of variety patents issued for corn and soybeans far exceeds that of PVP certificates.

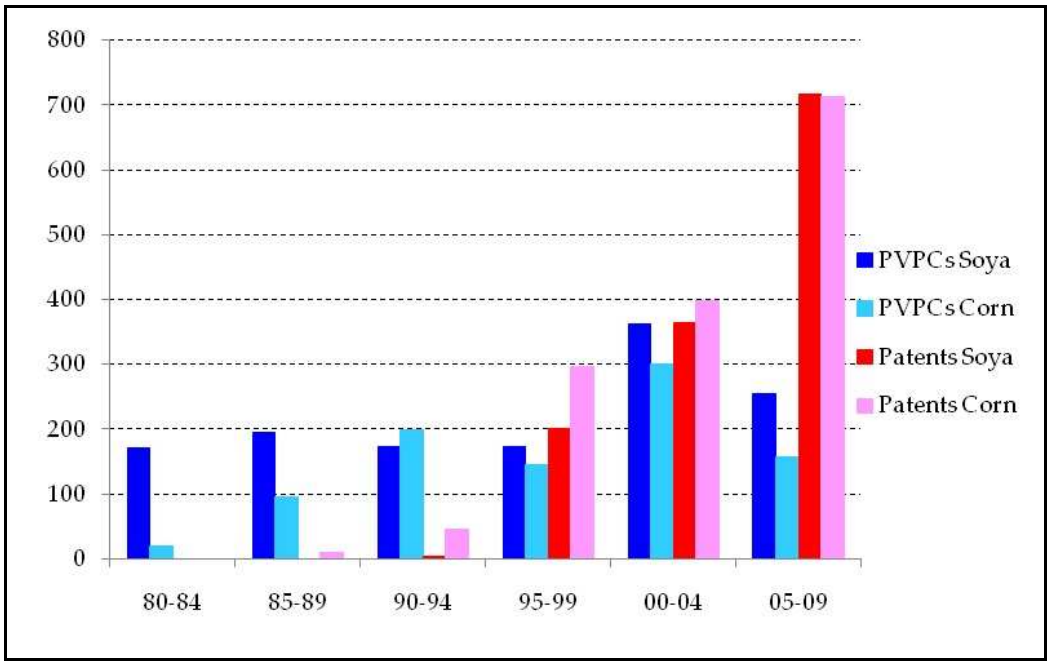

Figure 1. Number of U.S. PVPCs and Patents on Varieties, 1980-2009 (Source: USDA and USPTO)

Monsanto was not in the seed business prior to the advent of agricultural biotechnology, and it is now the largest seed company in the world. This remarkable evolution has its roots in the advent of agricultural biotechnology and the ability to engineer crops with herbicide tolerance and insect resistance traits (Economist, 2009). Such novel possibilities held the potential to profoundly affect farmers' demand for herbicides and pesticides, not just seed, and brought about a confluence between the agrochemical and seed industries. Monsanto invested early and decisively in agricultural biotechnology, leading to the release of GM varieties, first commercialized in 1996. Its early advantage and continued commitment to this R&D path has

resulted in a dominant position in the GM traits found in commercialized varieties of soybeans, cotton, and corn. This is illustrated in Table 1, which is based on data made available by Monsanto to its investors, but percent values in this table are calculated based on USDA planted acres. Note that the share of U.S. grown crops containing one or more Monsanto traits has increased steadily over time. In 2009, this share amounted to 81.1% in corn, 94.5% in soybeans, and 78.9% in cotton.

Table 1. Market Penetration of Monsanto's GM Traits, United States (Million Acres)

		2000	2005	2009
CORN	Single-Trait	17.2	27.8	14.1
	Double-Trait	0.1	13	4.5
	Triple-Trait	0	1.3	31.2
	RR w/ Non-Monsanto Traits	0	0.5	20.7
	Total Monsanto Trait	17.3	42.6	70.6
	% of total planted acres	**21.8**	**52.1**	**81.1**
COTTON	Single-Trait	5.6	3.2	1.2
	Double-Trait	4.1	7.7	5.3
	RR w/ Non-Monsanto Traits	0	0	0.7
	Total Monsanto Trait	9.7	10.9	7.1
	% of total planted acres	**62.6**	**76.8**	**78.9**
SOYBEANS	Roundup Ready	45	66.4	71.7
	Roundup Ready 2 Yield	0	0	1.5
	Total Monsanto Trait	45	66.4	73.2
	% of total planted acres	**60.4**	**92.1**	**94.5**

Source: Monsanto.

GM traits such as herbicide tolerance or insect resistance are attractive to farmers because they offer both cost-reducing and yield-increasing opportunities. But clearly, to capitalize on this latent demand, GM traits need to be embedded into seed varieties available to farmers. To achieve the market penetration in GM traits illustrated in Table 1, Monsanto appears to have followed a two-pronged strategy. First, it acquired several seed companies that offered both a

solid germplasm base and a recognized brand name, including Asgrow for soybeans in 1997, Dekalb for corn in 1998, and Holden's Foundation Seed—a firm supplying corn inbred lines to other breeders—in 1997. These acquisitions provided an immediate, sizeable presence in the seed market and a vehicle to market its GM traits. Second, from the beginning Monsanto engaged in broad licensing of its GM traits to other seed companies, from small regional firms to large competitors. This broad licensing strategy leveraged the stock of elite germplasm held by other companies, as well as their seed commercialization channels, and thus allowed GM traits to be made available to more farmers much more quickly. This successful strategy, of course, relied on the credible threat of a do-it-alone alternative made possible by the earlier seed company acquisitions, which also gave Monsanto considerable bargaining power in defining the clauses of its licensing agreements.

The foregoing discussion suggests that ownership of the germplasm is just as critical as the ownership of GM traits in order to understand the current status and possible future evolution of this industry. Table 1 provides some indications of the dominant position in GM traits accumulated by Monsanto, although one should note that other companies—including Dow AgroSciences, Syngenta, and DuPont—have competing GM traits that have been commercialized or are set to come to market. Conversely, Table 2 provides an indication of germplasm ownership by looking at utility patents for inbred lines, cultivars, and varieties for corn and soybeans, over the last 15 years. These are the patent count data used in Figure 1; soybean patents for which Monsanto and Stine are joint assignees are counted as half for each. Grouping these patent counts by company, accounting for the various mergers and acquisitions that took place over this period, Table 2 illustrates the dominant position of the top two companies, DuPont and Monsanto. The table also suggests the weakness of Dow, a company that

has developed successful insect resistance traits but which apparently does not have a comparable strength in germplasm platforms. Stine is a newer company that has focused its energy on soybean breeding. Also apparent is the absence of the public sector in patented germplasm, perhaps surprising given the general trend of increased university patenting promoted by the 1980 Bayh-Dole Act. Neither Table 1 nor Table 2, of course, depicts market shares in actual commercialized seeds. On that front it is thought that the top two companies currently have comparable strength in corn and soybeans. For 2009, industry sources put Monsanto's share of the corn seed market a bit above one–third, DuPont's share a bit below one–third, with Syngenta a somewhat distant third with perhaps 7-8% of the market. In the branded soybean seed market, in 2009 Monsanto's share was near 30%, DuPont's share a bit lower but in the 25-30% range, and Syngenta again third with about 10%.

Table 2. Distribution of Ownership for Utility Patents on Varieties, 1995–2009 (%)

	Corn	Soybeans
DuPont	45.70	21.90
Monsanto	34.70	41.70
Syngenta	9.30	6.80
Dow	2.30	–
Stine	–	18.10
Other private	7.70	11.20
Public	0.20	0.30

Source: USPTO.

Tension Between IPR and Antitrust Laws

Both IPR laws and antitrust laws share a common ultimate objective—to increase efficiency and thus improve the welfare performance of a market economy. But efficiency considerations in an innovation context are subtle, and there remains an unresolved tension between the prescriptions of IPR and antitrust laws. IPR law aims at increasing welfare by promoting innovation. For this

purpose, the grant of exclusivity is crucial in providing incentives for private R&D. And, exclusive control of an innovation necessarily confers some market power. Antitrust law aims at increasing welfare by promoting efficiency. Whereas monopolistic positions are not prohibited per se, certain activities that lead to the acquisition or exercise of market power are banned. From the perspective of IPRs, taking an *ex ante* perspective is of paramount importance, and it is recognized that to obtain dynamic innovation gains one may need to incur, *ex post*, some static efficiency losses. This trade-off is inherent to the second-best nature of IPRs, but it is a profitable bargain for society, a result that is robust even in the sequential innovation setting that characterizes crop breeding (Moschini and Yerokhin, 2008). But *ex post*, from the perspective of antitrust practice, monopolistic positions that result from IPRs are quite visible, and sorting out what is a legitimate exercise of IPR-related exclusivity from exclusionary practices that are proscribed by antitrust statutes remains difficult.

The objective of combining GM traits and germplasm held by different parties gives rise to the need for licensing agreements that are typical of so-called technology markets. Licensing in this context is generally held to have procompetititve effects because it facilitates the integration of complementary factors of production that are essential to assemble a product that has market value. But it is well known that restrictive and exclusionary licensing arrangements may run afoul of antitrust rules. The *Antitrust Guidelines for the Licensing of Intellectual Property* issued by the DOJ and the Federal Trade Commission (FTC) attempt to clarify this tension (DOJ and FTC, 1995). These agencies "recognize that intellectual property licensing allows firms to combine complementary factors of production and is generally procompetitive," they "will not require the owner of intellectual property to create competition in its own technology," and note that "the fact that intellectual property may in some cases be

misappropriated more easily than other forms of property may justify the use of some restrictions that might be anticompetitive in other contexts." But they also note that the *per se* illegality of a number of restraints—such as price fixing—continues to apply to the licensing of intellectual property. Furthermore, other restrictive licensing practices, such as exclusive licensing, exclusive dealing, and tying arrangements may be found to violate antitrust under the rule of reason, notwithstanding the recognized distinctive attributes of technology and innovation markets.

Impact on Farmers

Farmers benefit from improved seed varieties because of increased expected yields and, with GM traits, cost-reducing production practices—for example, reduced need for pesticides with Bt varieties; simpler and less expensive weed control with herbicide tolerant plants. But such benefits come at a price—indeed, collecting a higher seed price from farmers for improved seeds is a necessary component of the model whereby users pay for the underlying R&D carried out by seed and agrochemical companies. The exclusivity granted by IPRs allows the innovator to charge a higher price for the improved seed. Just how much depends on a number of issues, including whether the innovation is drastic or nondrastic and whether or not the preinnovation industry is competitive (Moschini and Lapan, 1997). Not surprisingly, therefore, we have seen higher prices for biotech seed varieties. Some insights are revealed by data available from the US Department of Agriculture (USDA), which started to report separate prices for biotech and nonbiotech seed varieties in 2001. Such price data, for corn and soybeans, are reported in Figure 2.

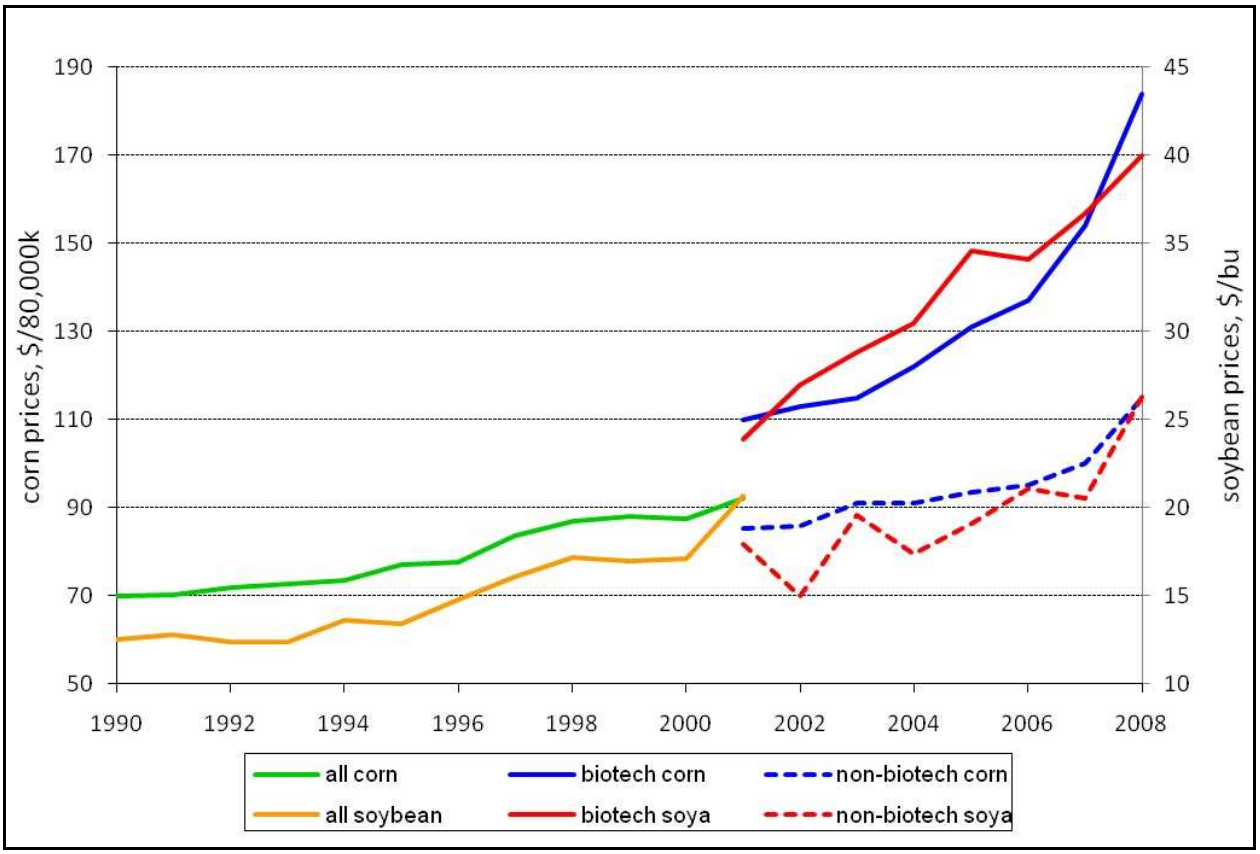

Figure 2. U.S. Seed Prices for Corn and Soybeans, 1990-2008 (Source: USDA)

It is clear that, for both of these crops, seed prices have increased considerably since the introduction of GM crops in 1996, for both biotech and nonbiotech varieties. Simply comparing the last available year (2008) to the pre-GM year of 1995, we see that the total seed price increase over this period is 139% for biotech corn, 49% for nonbiotech corn, 199% for biotech soybeans, and 96% for nonbiotech soybeans. Also of some interest is the price markup charged for GM seeds, relative to nonbiotech varieties. Based on the aggregate data reported by the USDA and used for Figure 2, for corn this markup has increased from about 29% in 2001 to 60% in 2008. Arguably this reflects, among other things, the increased importance of stacked traits in GM corn seed varieties, which now commonly combine herbicide resistance with a few insect resistance traits, such as against corn borer and corn rootworm. The situation is somewhat different for soybeans, in which biotech varieties over this entire period have simply contained

the same herbicide tolerance traits. Monsanto's marketing strategy for its Roundup Ready trait at first singled out the markup as a distinct technology fee, initially $5 per bag and then $6.50 per bag. But in 2001 Monsanto replaced this technology fee paid by growers with a royalty system paid by the seed companies licensed to use the trait, leaving the companies with more flexibility on pricing their product. Coincidentally with this change, it is apparent that the markup for essentially the same herbicide tolerance trait in soybeans increased substantially. This markup, which amounted to about 40% of the seed price under the technology fee system prior to 2001, has averaged 70% over the period 2004-2008.

Looking Forward

For some of the main U.S. crops, the consolidation that has occurred in the seed industry over the last 15 years has been accompanied by remarkable changes driven by the advent, and strong adoption, of GM crops and by the increased role of IPRs. Monsanto played a pioneering role in the development of GM traits and at present enjoys a dominant position in such a technology market, although other companies have developed or acquired a growing set of competing products. For the purpose of marketing such innovations to farmers, as noted, GM traits need to be combined with elite germplasm, the ownership of which is also rather concentrated and very much affected by the strengthening of IPR protection in this area that has occurred steadily over the last 30 years. Licensing of GM traits is thus an essential component of current industry practices. Allegations of anticompetitive practices in this setting have surfaced repeatedly in recent years (Moss, 2009). They include exclusionary practices such as exclusive dealing arrangements that penalize licensees for dealing with other technology providers, offering rebates to seed distributors who limit sales of competing seeds, and anti-stacking restrictions. A conclusive assessment of the economics of such alleged actions, however, is problematic at

present. The licensing of intellectual property entails a number of complex issues, as discussed, and the need to safeguard the incentive role of IPRs means that efficiency effects might be construed even for very restrictive clauses. Also, licensing contracts in this setting are a private matter between the contracting parties, and their details are typically not in the public domain, which is helped by the common practice of settling litigations out of court.

An interesting new issue that will be played out in the next few years concerns the potential for "generic" GM traits. Similar to the case of pharmaceuticals, the expiration of patents in principle opens the door for suppliers of generic GM seeds. Many patents typically pertain to any one GM trait, but the last controlling patent for the original soybean Roundup Ready (RR) trait is set to expire in 2014, and the real possibility of having generic versions of RR soybeans is exciting to many observers. The process will not be straightforward, however. The RR trait is wrapped up in branded seeds, and ownership of the underlying germplasm might play a role. If IPRs on such seeds were relying on PVP certificates, then seed saving by farmers might be a viable solution, at least for soybeans. But existing utility patents on GM varieties, which, as noted, have become more and more common in recent years, were they to be asserted, could preclude ready availability of generic GM seeds. There are also a host of regulatory matters that are germane in this case. While it is in the process of replacing the original RR trait in its seeds with a second-generation version with a longer patent protection, as well as other claimed advantages, Monsanto has also promised to maintain global regulatory support, through 2017, for the original RR trait. It is also on record as being willing to help maintain foreign registration beyond that by making available health and safety data needed for regulatory approvals. How all this will play out remains to be seen but, as with other issues in this industry, it will provide newer and challenging material for economic and legal analyses.

For More Information

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Assessing Competition in the U.S. Beef Packing Industry

Clement Ward
JEL Classifications: L13, Q13

Competition issues in the beef industry can be traced to the late 1880s and stemmed in part from market structure changes of an evolving economy. Railroads, improved highways, irrigated grain production, and technological changes within meatpacking plants combined over time to alter cattle feeding and marketing and the market structure of the U.S. meatpacking industry. Along the way, court decisions and Congressional actions altered the regulatory environment. Most notably, the Supreme Court issued the Packers' Consent Decree in 1920 and Congress passed the Packers and Stockyards Act of 1921. The Act created the Packers and Stockyards Administration, now called the Grain Inspection, Packers and Stockyards Administration (GIPSA), within the U.S. Department of Agriculture (USDA).

The consent decree and formation of a regulatory agency in USDA may have reduced some of the concerns about beef industry competition for a time, but many of the same competition issues surfaced not too many years later. Following a study in the 1930s, Nicholls (1940) wrote, "*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.*"

One might trace what could be referred to as the modern era controversy to the late 1960s when Iowa Beef Processors began to be a major force in the meatpacking industry. The

technological innovation of boxed beef had a major effect on market structure and economics of the meatpacking industry. Since the late-1980s, concentration in meatpacking has been high by many economists' standards, above levels considered by some economists to elicit noncompetitive behavior and result in adverse economic performance.

This article focuses on the period since the 1970s. Its objectives are to: (1) put beef packing competition issues in historical perspective, (2) highlight market structure changes in beef packing, (3) note some key lawsuits and court rulings that contribute to the regulatory environment, and (4) acknowledge the large body of research related to concentration and competition issues.

Structural Changes and Causes

What led to high levels of concentration in beef packing? Here is a quick review of structural changes which occurred especially in the 1970s and 1980s in the beef packing industry. In 1976, there were 145 steer and heifer slaughtering plants with annual slaughter of 50,000 head or more (GIPSA, 2008 and previous annual reports). Some meatpacking firms own a single plant and some are multiplant firms. Plants with annual slaughter exceeding one-half million steers and heifers numbered five and accounted for 14.8% of slaughter by firms in the category of 50,000 head or more per year. Average slaughter in these largest five plants averaged 666,800 head.

Comparable data for 2006, the last year data were reported, illustrate major market structure changes. The number of plants in the category of 50,000 head or more per year declined to 36. Fourteen plants each slaughtered one million or more steers and heifers in 2006. These 14 plants accounted for 70.2% of total steer and heifer slaughter in the 50,000 head or more size group. Average slaughter per plant in the 14 largest plants nearly doubled from 1976 to 1,302,643 head in 2006. The same trend can be identified for boxed beef processing plants.

Not only did plant size increase, growth and consolidation resulted in larger beef packing firms as well, which in turn increased concentration. The four-firm concentration ratio (CR4), the combined market share of the four largest firms, is one common measure of how economically concentrated an industry or market is. In theory, the higher the CR4, meaning the closer it approaches 100%, the greater the likelihood the four largest firms are exercising market power. Market power may be either oligopolistic power of a few dominant sellers in the output market or oligopsonistic power of a few dominant buyers in the input market, reflecting significant influence on the market by a few firms. Economists have debated for years whether or not the CR4 is an appropriate or inappropriate measure of market power; but regardless, it continues to be a measure of concentration.

In 1976 for steer and heifer slaughter, the four largest firms accounted for 25.1% of total steer and heifer slaughter (a CR4 of 25.1) according to GIPSA data. By 2007, CR4 was 80.0 for total steer and heifer slaughter as well as for boxed beef production. However, the four largest firms in 1976 were not the same as the four largest firms in 2007 due to several mergers and acquisitions.

The sharp trend toward fewer and larger plants was driven by the enhanced economic efficiency and cost management associated with operating larger firms. MacDonald and Ollinger, (2005) cite technology combined with a sharp reduction in packer costs as contributing factors for consolidation in beef packing. Meatpacking is a margin-driven business. Firms buy livestock at a small range around the market average price. Meatpackers do not control the market average price; the result of price determination. Meatpackers do not directly control the supply of cattle raised and do not directly control demand by consumers for beef products. But packers can influence prices paid around that average price level; the result of price discovery.

They subsequently sell meat and byproducts 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, gross margins are about the same for all firms and the firm with the lowest costs experiences the largest net margin or profit. As a result, firms search for ways to control costs. Thus, one of the driving forces in market structure changes was the need to be a low-cost slaughterer and processor.

Studies in the 1960s through the 2000s have found economies of size in cattle slaughtering and fabricating, and research confirms firms operate larger beef packing plants in order to be competitive (Ward, 2010). As noted by Ward, economies of size findings are quite robust across a variety of analytic approaches—economic engineering, simulation, and statistical cost analysis—and data—both cross-sectional and time series.

Similarly, plant utilization 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 must operate at high levels of utilization. A larger plant at lower utilization rate may in fact have higher costs per unit than a smaller plant operated at near-capacity utilization. Research in the 1980s to 2000s also confirms the importance of plant utilization and that larger plants operate at higher plant utilization than smaller plants (Ward, 2010). Thus, larger plants have lower costs per unit than smaller plants both because they are larger and because they are operated at higher utilization.

Plant operating behavior leads to dynamic structural changes. For example, when a firm expands a plant, say from one-half million cattle per year to one million cattle per year, either by expanding the plant or operating the plant two shifts per day, the plant experiences lower per-head operating costs. Importantly also, one-half million cattle previously slaughtered by other

plants are now slaughtered in a single plant unless other factors intervene. 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, go out of business, and concentration in meatpacking increases. Again, research has confirmed this market structure dynamic.

Market structure changes since the 1970s, including increased concentration, involved both firm consolidation as well as internal growth from capitalizing on plant economies. The industry evolved away from the old-line meatpacking firms that were household names for years, such as Swift, Armour, Wilson, and, Cudahy to firms like IBP, Excel, and, Swift Independent, and later to firms we have today, JBS, Tyson, and Cargill. Thus, concentration also increased from mergers and acquisitions involving the largest firms.

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. Little research is available to determine how many plants a firm needs to capitalize on economies of firm size. Advantages are assumed for multiplant firms in procuring livestock for several plants. Increasing pressures related to food safety suggest another advantage for multiplant firms and examples could be cited where single-plant firms experienced a food-safety crisis that led to the firm's eventual demise. There also may be economies of scope available to firms that handle multiple meat species—beef, pork, and poultry—relative to firms that specialize in a single meat. Paul (2001) found evidence that larger and more diversified plants in terms of processing operations have greater technological economies than smaller plants.

Pricing Behavior Changes

Another clear trend coincident with increasing concentration is increased packer procurement of livestock by non-cash-price means. The first year GIPSA collected data on contracting by the four largest beef packing firms (1988), forward contracts and marketing agreements—distinctly different but combined by GIPSA for reporting purposes—accounted for 15.8% of steer and heifer slaughter and packer ownership of fed cattle accounted for 4.7%.

Considerably more and better data are available today on packer procurement methods as a result of the Livestock Mandatory Reporting Act. Beginning with its implementation in April 2001, data are now available on weekly prices and volumes of livestock procurement by alternative marketing methods (Ward, 2009a, 2009b).

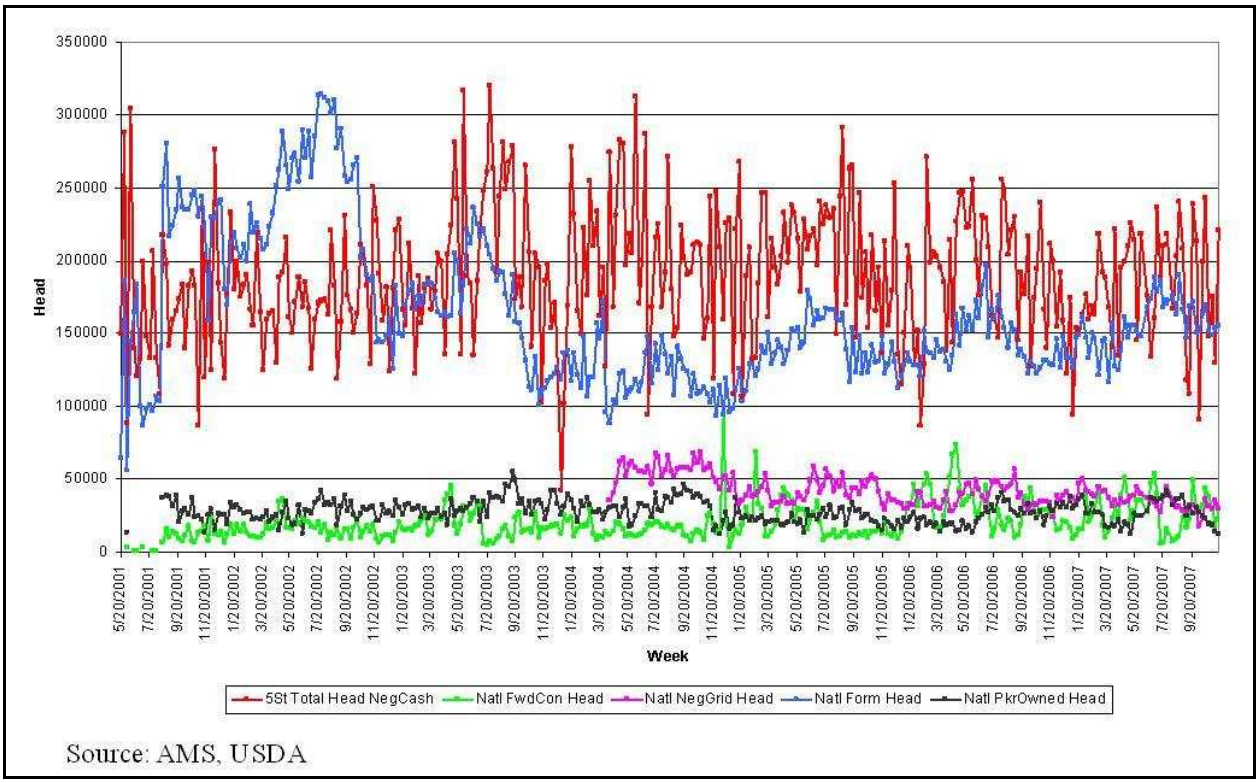

Figure 1. Weekly Fed Cattle Pricing Methods by Packers since Mandatory Price Reporting, 2001-2008

Alternative marketing arrangements for fed cattle include negotiated cash trades, negotiated grids—which specify prices for a range of price-quality combinations with the base price resulting from buyer-seller negotiation, formula priced trades typically with the base price tied to

a cash market quote or plant average cost, forward contracts typically with price tied to the futures market or future market basis, and packer–owned transactions for which no price is reported since they are typically internal transfers from one division of the packing firm to another.

The percentage of fed cattle purchased by packers through alternative methods has changed as follows over the 2002-2010 period since the new data have been reported. Negotiated cash went from 43.8% in 2001-02 to 34.1% in 2009-10; negotiated grid pricing, from 12.4% for 2004-05 when reporting began to 7.5%; formula agreements, from 48.9% to 43.0%; forward contracts, from 3.0% to 10.3%; and packer–owned, from 6.2% to 5.1%. Thus, there has been a trend away from the cash market and toward alternative marketing arrangements over the past decade. Figure 1 shows the variability in weekly fed cattle procurement by alternative procurement methods.

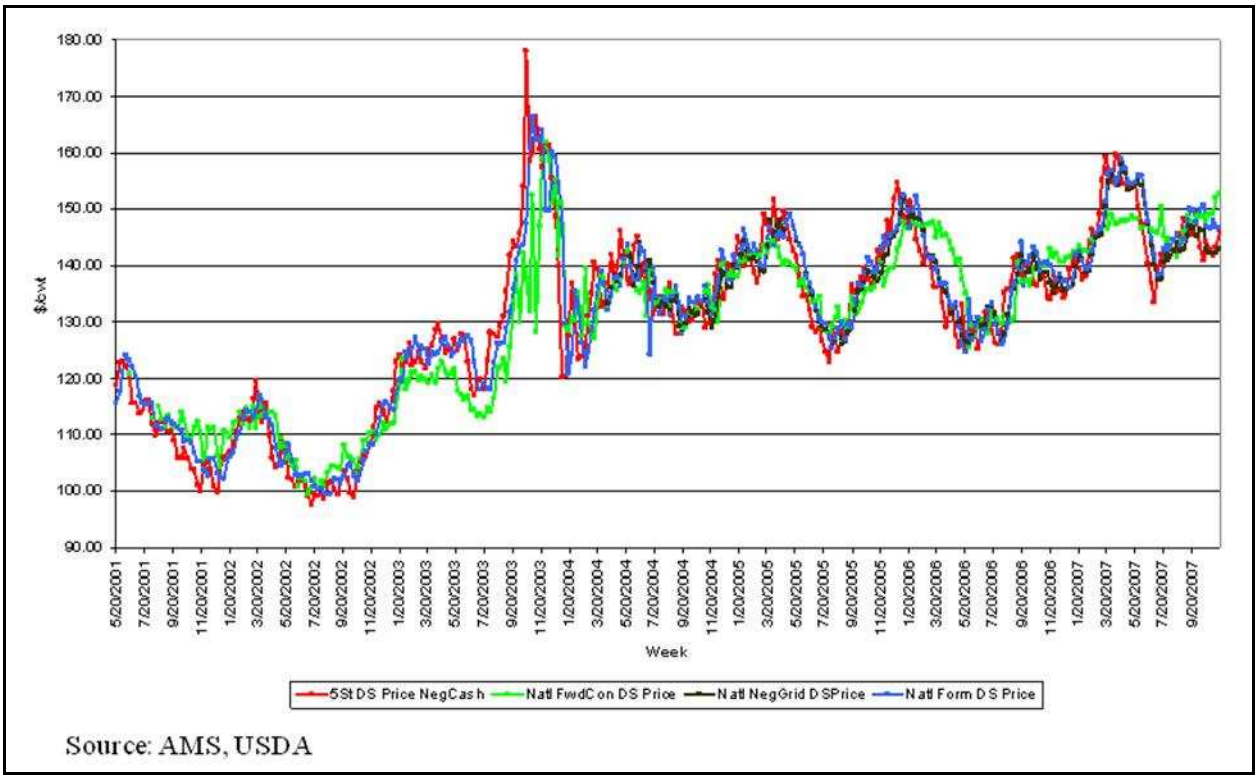

Figure 2. Comparison of Fed Cattle Prices by Alternative Procurement Methods since Mandatory Price Reporting, 2001-2008

Just as the extent of packer procurement of livestock by alternative methods is important, so is the relationship among prices by alternative methods. Figure 2 shows the weekly prices for fed cattle by procurement method. Prices for fed cattle track relatively closely for negotiated cash, negotiated grid, and formula agreements but forward contracts do not track the others as closely. The mechanics related to each method and the timing of reported prices for forward contracts explains many of the differences over time, but not necessarily for any given week (Ward, 2008).

Lawsuits and Regulatory Implications

While concentration is high in meatpacking, civil antitrust lawsuits filed against the largest meatpacking firms have not resulted in major court decisions against those largest firms in the past thirty years. And no significant Federal government antitrust cases have been brought against the largest meatpacking firms over the same period.

Civil antitrust lawsuits at three points in time seem relevant. Market power, oligopsonistic behavior, and price discovery were issues to some producers in the 1970s even though the CR4 in steer and heifer slaughtering was not high by economists' standards. Two class action antitrust lawsuits, referred to as the Meat Price Investigators Association (MPIA) case and the Bray case, were filed against (in total) the four largest grocery retailers, four largest beef packers, and the leading private market reporting firm. The MPIA case was filed in 1975 when the CR4 in steer and heifer slaughtering was 25.3. After several years of litigation, both cases were dismissed in the early 1980s.

A different type of lawsuit was filed in 1985 by Monfort of Colorado, then one of the largest beef packing firms, against Cargill which was a large competitor. Cargill agreed to purchase a competing beefpacker of both firms, Spencer Foods. Monfort deemed the acquisition

anticompetitive both to itself and the industry, but the courts ruled in favor of Cargill and allowed the merger to proceed. The Monfort case was filed when CR4 in steer and heifer slaughtering was 50.2, and the court's decision had a quick and lasting impact as it opened the door to several mergers and acquisitions involving some of the largest meatpacking firms. In 1987 alone, the CR4 in steer and heifer slaughter increased by 12 percentage points, from 55.1 to 67.1.

By the mid-90s, the CR4 in steer and heifer slaughter had risen to about 80. Cattle producers filed a class action lawsuit against IBP in 1996, known initially as the Pickett v IBP case, and later called the Pickett v Tyson Fresh Meats case after Tyson purchased IBP in 2001. A jury in Federal court ruled in favor of the plaintiffs in 2004 and assessed damages of $1.28 billion. However, shortly thereafter, the trial judge set aside the jury ruling and entered a summary judgment in favor of Tyson which was later upheld by an Appellate court.

These lawsuits are relevant for two reasons. Figure 3 shows the reported CR4 in steer and heifer slaughter and boxed beef production since 1972 based on GIPSA data (GIPSA, 2008). In addition, filing dates of the three lawsuits are identified. Note the difference in concentration at each time period. Producers and competitors have been concerned about concentration and competition for many years, but to date insufficient evidence has been presented to rule in favor of those concerns. A reason for this relates to the mixed research results by economists, as noted later in this article. While regulatory agencies, notably GIPSA and the Department of Justice (DOJ) have been routinely criticized for not halting the trend in concentration, civil lawsuit outcomes may have influenced their decisions regarding potential antitrust regulation.

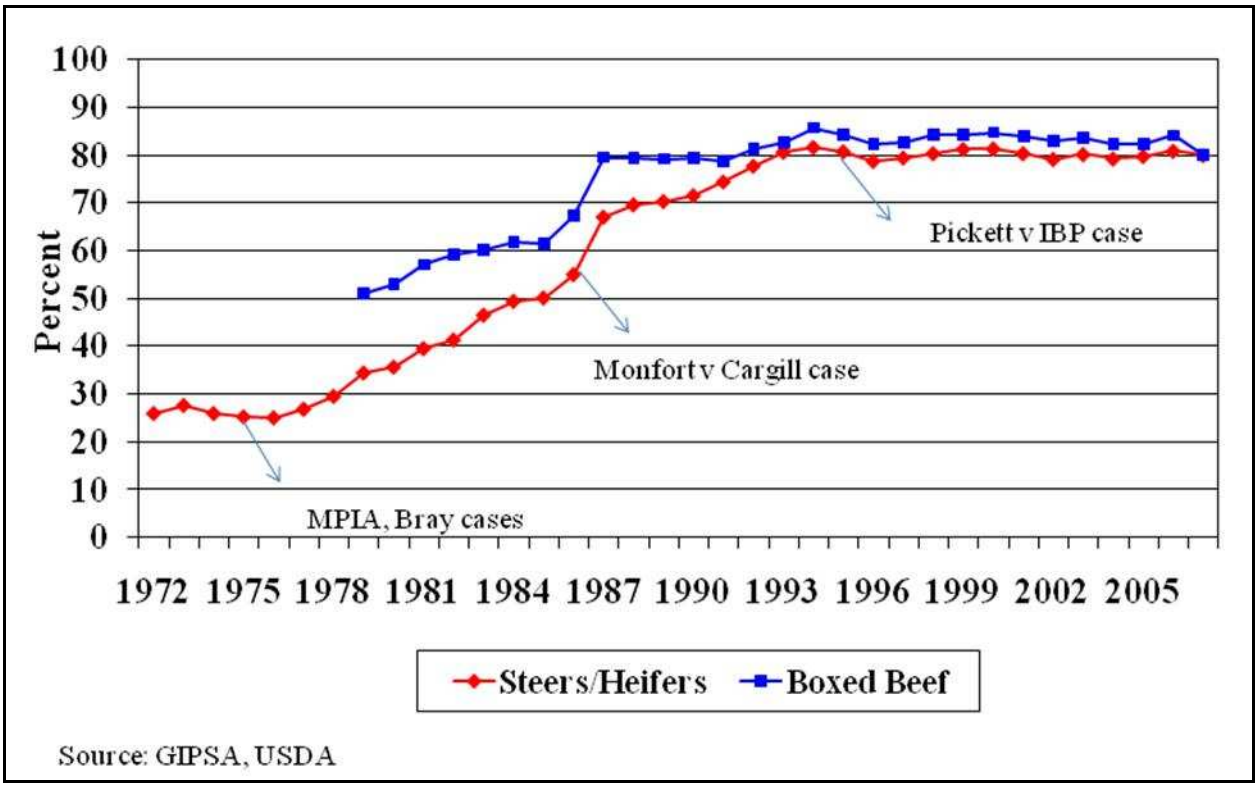

Figure 3. Four-Firm Concentration in Steer and Heifer Slaughter and Boxed Beef Production with Selected Civil Antitrust Lawsuits, 1972-2007

Meatpacking Behavior and Performance Research

Agricultural economists have conducted considerable research over the past three decades related to behavior and performance of livestock and meat markets, with considerable focus on the meatpacking industry. Ward (2010) reviewed a number of articles in roughly chronological order (see the review at the Department of Justice website http://www.justice.gov/atr/public/workshops/ag2010/index.htm#publiccomments). Research varies widely in terms of data—data unit aggregation from individual transactions to annual observations, collection length from one month to decades, and spatial aggregation from local market to the entire United States—as well as methodological approach, including numerous econometric models, simulation, game theory, etc.

An extensive review of competition in meatpacking concluded that the body of empirical evidence was insufficient to persuasively argue the meatpacking industry was not competitive (Azzam and Anderson, 1996). Sexton (2000) concluded that market power estimates in meatpacking are modest and structural changes on balance are probably beneficial from an efficiency viewpoint. Any single piece of research has its weaknesses in data and methodological approach, suggesting the need to consider the entire body of research.

Two summary statements can be made from the Ward (2010) review. First, relatively consistent research on pre-committed—captive—supplies suggests use of alternative marketing arrangements by packers is associated with lower cash market prices for livestock though the magnitude of lower prices is quite small. However, research fails to connect this finding to abusive use of precommitted supplies. In the most recent Congressionally mandated study, economists found cost savings and quality improvement associated with meatpacking firms' use of precommitted supplies, referred to in the study as alternative marketing arrangements, outweighed the effect of oligopsony market power (GIPSA Livestock and Meat Marketing Study, 2007).

Second, research on oligopoly/oligopsony power is mixed (Ward, 2010). Game theory research provides evidence packer behavior is consistent with a trigger pricing strategy. Where market power has been found, whether oligopoly power or oligopsony power, the market power magnitude is relatively small in most cases and seemingly within an "acceptable" public policy level. But there are exceptions, and at least one study found a larger magnitude which exceeds the "acceptable" public policy level.

Research on price impacts and market power estimates begs the question, "How large is large?" or "How small is small?" Price distortions of 3% or less have been found in several

studies. These fall well short of regulatory agency standards related to merger impacts and noncompetitive behavior, often assuming a 5% price impact rule (U.S. Department of Justice and Federal Trade Commission, 1997). However, the courts and regulatory agencies have not defined specifically how much market power is "significant" and for how long a firm or firms must maintain significant market power.

From a different perspective, seemingly small impacts in $/cwt can 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.

Major Questions Remain

A major question relating to market structure changes and increasing concentration is what should be done or what can be done to reverse the trend? Some people want to do nothing and allow the marketplace to function unencumbered by external regulations and constraints. Other people would administratively alter the market structure where problems seemingly occur. For example, they would break up large meatpacking firms; and/or restrict presumed problematic behavior, such as eliminate contracting and vertical integration which includes packer ownership of livestock.

No definitive answer is attempted here, but a few concluding observations are offered.

- From a long historical perspective, names of meatpacking firms change but many of the same allegations of meatpacker abuse continue.
- Evidence of structural changes is clear. Meatpacking firms have increased greatly in size both from internal growth as well as mergers and acquisitions. The result has been fewer and larger plants, fewer and larger firms, and much

higher levels of concentration.

- Evidence of behavioral changes is clear also. Meatpacking firms no longer rely solely on the cash market for livestock purchases. These changes are in response to livestock owners' preferences as well as the need for improved coordination and reduced costs to be competitive with rival firms and for beef to compete with other meats.
- Lastly, research findings do not consistently and convincingly identify serious problems, though many studies point to potential problems and raise several issues. Determining the need for legislative or regulatory reform is difficult, as is identifying what the reform measures should be that would be corrective, without being disruptive and injecting unintended, negative consequences onto the marketplace.

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Hog Marketing Practices and Competition Questions

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JEL Classifications: Q11, Q13

Hog production and marketing practices in the U.S. pork industry have changed dramatically over the past two decades. In the early 1990s, nearly 90% of hogs were purchased in the spot market through auctions, dealers or directly by packers. By early 2010, the percent of spot market hogs had fallen to 5-7%. Approximately 25% of hogs are owned and processed by packers in their own plants and 70% of hogs are traded between seller and buyer through marketing contracts. The contracts vary in duration and specification but are similar in that the transaction price is derived by a formula based on another market, often the now very thin spot market. The motivations of sellers and buyers to abandon the spot market may still exist, but the thin spot market raises concerns. Prices in these thin markets potentially may become highly volatile, subject to manipulation, and less representative of competitive market equilibrium (Martinez, 1999). Some producers and Congress are looking to reverse the trend by requiring packers to purchase a percentage of their needs in the spot market (Taylor, Muth and Koontz, 2007). Yet, other producers that value contracting are evolving to the next generation of contracts and alternative methods of price discovery.

This paper summarizes recent trends in hog marketing practices using USDA data and explores the motivations for increased reliance on procurement contracts. Next, a description of recent important research results is set out, followed by a brief discussion of the implications of

marketing arrangements. Finally, it identifies some unresolved issues that deserve thoughtful consideration by the industry, researchers and policy makers.

Recent Trends

The pork industry has undergone significant changes in efficiency, structure, and organization over the last two decades. Hog production was once dominated by small enterprises as part of diversified farms. As a point of reference, in 1993 there were over 235,000 farms with hogs and two-thirds of the U.S. hog inventory was on farms with less than 2,000 hogs, the largest category USDA reported at the time (USDA-NASS, 1993). Also, in 1993, 87% of hogs were bought on the spot market (Hayenga et al, 1996). There were approximately 200 locations, either buying stations or packing plants, to sell hogs in Iowa and a representative producer had five or more different bids in a 50-mile radius in each quadrant of the state (Lawrence, et al. 1995). The industry barrow and gilt slaughter was 1.65 million head per week. Carcass-merit pricing—in which each carcass is objectively measured for weight and leanness—was new and the average hog had backfat of 1.07” on a 179 pound hog carcass. In this system, relative to a base price, premiums are paid for leaner carcasses of ideal weight and discounts are paid for fatter carcasses that are either too heavy or too light.

In 2009, 57% of hogs were owned by 130 producers with at least 50,000 head inventory (USDA-NASS, February 2010). Approximately 63,000 farms owned the remaining 43%. In the first quarter of 2010, 5-7% of hogs are bought on the spot market. There are fewer buying stations but independent buyers and commission firms still have a presence and at least seven different packers buy hogs in Iowa each week. Weekly barrow and gilt slaughter has increased 27% to an average of 2.09 million head per week. Virtually all hogs are bought on carcass merit and backfat is 0.75” on a 200 pound carcass. The number of producers is smaller, production is

larger, and hogs are larger and leaner. In addition to carcass merit buying, the move to larger and leaner hogs is closely linked to the use of marketing contracts that more precisely send signals of preferred traits from consumers to producers than do spot market transactions (Martinez and Zering, 2004).

Another change that occurred since the early 1990s which allowed producers to grow was the use of production contracts. The owner of the hogs pays a grower to provide the building, utilities and labor to raise hogs to slaughter weight with the owner retaining ownership of the hogs, providing the feed, veterinary supplies and management decisions and standing price risk in the feed and hog markets. According to USDA, the total number of hogs under production contract owned by operations with over 5,000 head, but raised by contractees, accounted for 44% of the total U.S. hog inventory (USDA-NASS, March 2010). While often confused and used interchangeably, it is important to recognize the difference between production contracts and marketing contacts. Production contracts make provision for payments from the contractor/hog-owner to the grower/contractee for the housing and other costs associated with raising the hogs. Payments under the terms of the contract are relatively stable providing reduced risk for the grower. Marketing contracts are used to transfer ownership of the hogs from the hog owner to the buyer—typically a packer/processor. The focus of this paper is on marketing contracts.

Between 1993 and 2002, spot market share of hog sales decreased from 87% to 17% and fell to 5-7% of barrow and gilt slaughter by 2010. Packer-owned hogs going to their own plant represents 26% of hogs marketed, while some form of marketing contracts accounted for approximately 60% of the market hogs sold. The largest single market contract category is “hog or pork market formula” meaning that the transaction price in the contract is tied to the spot market for hogs or wholesale pork.

The spot market represents 5-7% of the hogs marketed or approximately 20,000-30,000 head on a given day. Prices under USDA-Mandatory Price Reporting (MPR) are reported twice a day, mid-morning and mid-afternoon meaning that the price reported represents an even smaller number of hogs and transactions. With the small number of transactions per reporting period the potential for greater price volatility from one market report to the next increases as does the possibility that individual transactions can unduly impact prices higher or lower. Some hog marketing contracts base the hog price on wholesale pork prices. While in this formula the producer price increases when the packer price increases, the wholesale pork market is also thinly reported and is not covered under the current MPR legislation. The contracts may also include a "quality" adjustment to address the concern that spot market hogs are not representative of all hogs. Parties to the contract often use multi-day or weekly averages to reduce volatility impacts of thin markets. However, there is concern that if packer controlled supplies, owned or contracted, can be used to pressure the spot market lower, then the contract prices are lower as well. The impact on overall price levels resulting from price discovery involving a small number of hogs is discussed later.

Motivation for Marketing Contracts

The trend to increased use of hog marketing contracts to procure hogs was driven by both producers and packers. Consumers were asking for leaner and more consistent pork. New hog production technologies such as artificial insemination, lean genetics, phase and split-sex feeding and age segregated rearing, reduced costs of production and allowed large producers, in particular, to capture scale economies at the farm level. Transportation efficiencies, dedicated feed mills, and management skills generated scale economies at the firm level. Producers capturing the early adopter margins used production contracts to expand proven management and

production systems. However, lenders were reluctant to loan to modernize facilities or expand without assurances of market access and in some cases price risk management. A producer survey conducted in 2000 found that increased price and reduced price risk were identified as the most important relevance of marketing contracts following disastrously low prices in 1998-1999 (Lawrence and Grimes, 2001).

At the same time packers saw changing production practices and investments made in regions distant from the traditional Midwest hog belt and existing packing facilities. In addition to securing a more consistent, uniform supply of higher quality hogs for the life of the contract, packers gained other advantages that the spot market never evolved sufficiently to deliver (Lawrence, Schroeder and Hayenga, 2001). Marketing contracts are a form of nonprice competition for hogs that encourage production facility investment near packing facilities by assuring lenders that hog producers have access guaranteed to packer “shackle-space”. The terms of some contracts also provide for less hog price or margin risk. Packers competed with one another on contract terms that either impacted the base price, carcass-merit premiums or risk-sharing methods. Risk sharing provisions varied by company, but typically involved the producer giving up opportunity for possibly higher spot market prices in return for contract protection from low spot market prices. For a discussion of hog marketing contracts see Lawrence (1999).

USDA-AMS, through Mandatory Price Reporting, reports number of head, carcass characteristics and prices by purchase method. The risk sharing provisions of the contracts are evident in average annual prices (Figure 1). The spot market price is higher than contracts in some years, but lower in others. Marketing contracts typically have specifications that require producers to adopt industry standard best management practices and encourage production of leaner hogs, the primary measure of quality, among other characteristics. The hogs sold through

the spot market on average are not as lean as hogs sold under contract and have lower value in today's buying systems.

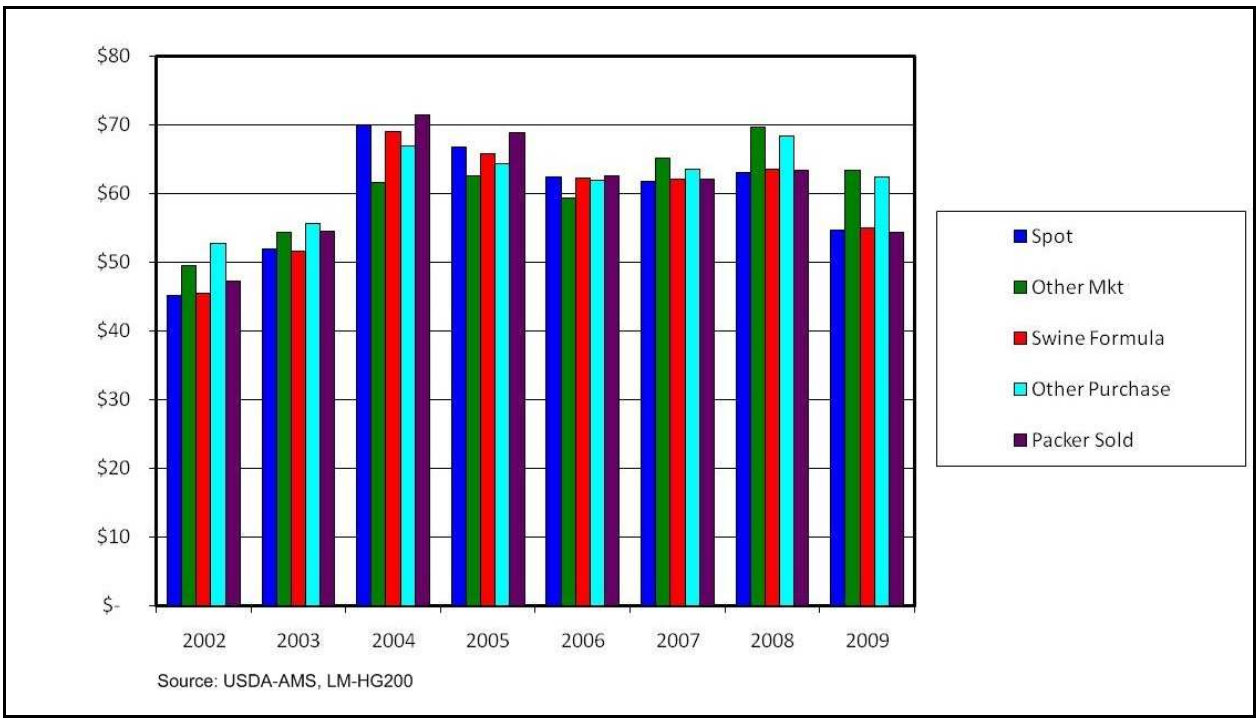

Figure 1. Lean Hog Prices ($/cwt), by Marketing Method

Relevant Research

Compared to the fed cattle market, there have been relatively few studies on the implications of market power—the ability of a firm or firms to influence price that is not possible in a perfectly competitive market—in the hog market. In a simulation model, Wang and Jaenicke (2006) found that for formula-price contracts increased contract supplies are negatively related to the expected spot market price when participating producers contract high proportions—greater than 0.8—of their hogs. However, they are positively related when producers contract lower proportions—between 0.6 and 0.8. Moreover, increased contract supplies reduce the variance of spot market price under formula-price contracts. They also found that formula-price contracts offer the highest expected profit to processors and highest expected utility to producers. The results imply that as long as a producer has a sufficient number of hogs in the spot market for negotiation that

contracting the remainder can be beneficial. Too few in the spot market and they lose their leverage. However, in today's market many producers contract all of their production and other producers do not contract any and thus the simulation results may not fit with today's market reality. Finally, the authors conclude that important linkage between the contract market and the cash market could disappear if cash markets become too thin and disappear altogether. With spot market volume near 5%, the sector may be at that point.

Perhaps the most comprehensive analysis of alternative marketing arrangements (AMA) in recent years is the Livestock and Meat Marketing Study (RTI International, 2007). AMAs are defined as an alternative to the spot market and include packer ownership and marketing contracts. Analyzing transaction data for October 2002 through March 2005 the authors found that on average packers that use a combination of marketing arrangements pay lower prices than slaughter facilities that use the spot market only. The RTI analysis found a statistically significant presence of market power by buyers to influence prices in live hog procurement. However, the results regarding the significance of AMA use for procurement of live hogs in explaining the sources of that market power are inconclusive; i.e., packers might have market power, but that power does not derive from AMA's. Thus, restricting AMAs is no assurance that market power will diminish.

There has been legislation proposed to restrict packer ownership and the use of marketing contracts. Some proponents of restrictions mistakenly cite the relationship between the change in AMAs and the change in hog prices reported in the RTI report as proof that hog prices would be higher with a larger spot market. The authors found that during the time period of the study, contracts had a bigger impact on price than did packer ownership. A 1% increase in contract hog quantities causes the spot market price to decrease by 0.88% and a 1% increase in packer-owned

hog quantities causes the spot market price to decrease by 0.28%. What is often ignored is that if the same hogs are put on the spot market that price will decrease 0.27% with each 1% increase in the supply of spot market hogs. In recent years U.S. hog slaughter has been slightly more than 100 million hogs, 32 million packer-owned hogs and 5 million spot-market hogs. Thus, a 1% decrease in contract marketings (630,000 annually) will increase the spot market price 0.88%. But, if the hogs are shifted to the spot market, they will increase that supply by 12.6% depressing prices by 3.4%. The math is similar, but not as dramatic for packer ownership. The point is that unless restricting contracts and packer ownership also restricts production, the hogs will simply be sold through the spot market increasing its supply and, at least in this analysis, offsetting the price increase associated with restricting AMAs. If, in fact, some producers are dependent on procurement contracts to secure financing as they were in the 1990s, then restrictions on contracts could force some operations out of business and thereby reducing pork supplies.

The RTI authors also modeled the vertical chain from hog farms to consumers. They factored in the cost advantages that packers have in operating their plants more efficiently when using AMAs and the impact on consumer demand from producing higher quality pork through AMAs—improved ability to deliver consumer preferred traits, such as uniformity, leanness, color, etc. They concluded that restrictions on the use of AMAs in the hog and pork industries would result in a net loss to both producers and consumers. Hog producers would lose because of the offsetting effects of hogs diverted from AMAs to the spot market, some increased costs of plant operations shifted back to producers and the decrease of consumer demand due to declining quality. Consumers would lose as wholesale and retail pork prices rose due to smaller supplies and some of the higher packer costs were passed downstream. Packers would gain in the short

run, but neither gain nor lose in the long run as they operate a margin business between producers and consumers.

Remaining Questions

Hog marketing practices have changed with the evolution of the industry and have provided motivation to both producers and packers to use marketing contracts rather than the spot market. Yet many hog marketing contracts rely on the spot market for price discovery leaving important questions worthy of consideration. For example, what are the necessary conditions for a viable spot market and what criteria define "viable"? What is the source of market power and what is the cost of controlling it? What are the effects of restricting marketing contracts? If producer loans are contingent upon marketing contracts, what is that impact on asset values if there are forced liquidations because marketing contracts are restricted? Likewise, what happens to the value of facilities if packers have put their production operations on the market at a time when other producers are selling farms and lenders are reluctant to loan without marketing contact assurances?

While the previous questions focused on implications of the spot market disappearing or of restrictions to force hogs back into the spot market, there are equally challenging questions regarding an alternative to the spot market. What will be the characteristics of the next generation of hog marketing contracts? Is market-based price discovery relevant in an industry that integrates producers more closely with consumers? What are the competition implications if the market trades contracts rather than hogs?

Whether trading hogs or contracts, issues of market performance and conduct remain. The USDA, Grain Inspection, Packers and Stockyards Administration (GIPSA) is proposing to add several new sections to the regulations under the Packers and Stockyards Act, 1921. The

new regulations that GIPSA is proposing would describe and clarify conduct that violates the P&S Act and allow for more effective and efficient enforcement by GIPSA. Additional research and development are called for to find workable solutions to industry questions particularly in the context of the proposed regulatory changes.

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Consolidation and Concentration in the U.S. Dairy Industry

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JEL Codes: L11, Q13, Q18

Consolidation of the U.S. dairy industry has occurred at every step in which raw farm milk is transformed into finished dairy products and made available to the final consumer. In addition to the usual public policy concerns associated with industry consolidation, there are some unique industry characteristics that make for special attention. These include the dominance of dairy cooperatives in the marketing of farm milk, daily production of the primary product, a formula based pricing system that determines minimum milk prices for a majority of the milk marketed in the United States and industry use of a thin market in the determination of a major component of this pricing system. This article provides an overview of recent consolidation trends of the U.S. dairy industry and highlights industry characteristics that differentiates dairy from other agricultural sub-sectors.

Consolidation in the U.S. Dairy Farm Sector

The average farm size is increasing, the number of dairy farms is decreasing and the location of production has shifted significantly to nontraditional production areas. The expansion of the dairy industry in such states as Idaho, Texas and New Mexico and concurrent reduction in production in traditional dairy states has resulted in the production by small farms in the historical producing areas being replaced by production originating from significantly larger operations (GAO, 2001).

Table 1 shows the change in the 10 largest dairy producing states since 1970. In 1970 only California (#4) and Texas (#10) were contained in this list. By 2008, there were five western states in the top ten with California producing the most milk and Idaho entering the top ten between 1980 and 1990 and by 2009 becoming the fourth largest milk producing state. Figure 1 shows the distribution of farms by herd size for a number of these key milk producing states in 2007. For the United States as a whole, the average herd size was 131 cows per operation. In comparison, for New Mexico (#8), the average herd size was 1,267 cows and for California (#1) the average herd size was 824 cows which is more than nine times the average herd size in Wisconsin (#2).

Table 1. Milk Production has Shifted to the West, Million Lbs

Rank	1970		1980		1990		2000		2008	
	State	Production (Mil. Lbs)	State	Production (Mil. Lbs)	State	Production (Mil. Lbs)	State	Production (Mil. Lbs)	State	Production (Mil. Lbs)
1	WI	18,435	WI	22,380	WI	24,187	***CA***	32,245	***CA***	41,203
2	NY	10,341	***CA***	13,577	***CA***	20,947	WI	23,259	WI	24,472
3	MN	9,636	NY	10,974	NY	11,067	NY	11,921	NY	12,432
4	***CA***	9,457	MN	9,535	MN	10,030	PA	11,156	***ID***	12,315
5	PA	7,124	PA	8,496	PA	10,014	MN	9,493	PA	10,575
6	IA	4,670	MI	4,970	***TX***	5,539	***ID***	7,223	MN	8,782
7	MI	4,602	OH	4,310	MI	5,234	***TX***	5,743	***TX***	8,416
8	OH	4,420	IA	3,994	OH	4,667	MI	5,705	***NM***	7,865
9	***TX***	3,065	***TX***	3,625	***WA***	4,392	***WA***	5,593	MI	7,763
10	MI	3,012	***WA***	2,942	IA	4,233	***NM***	5,236	***WA***	5,696

(Source: NASS)

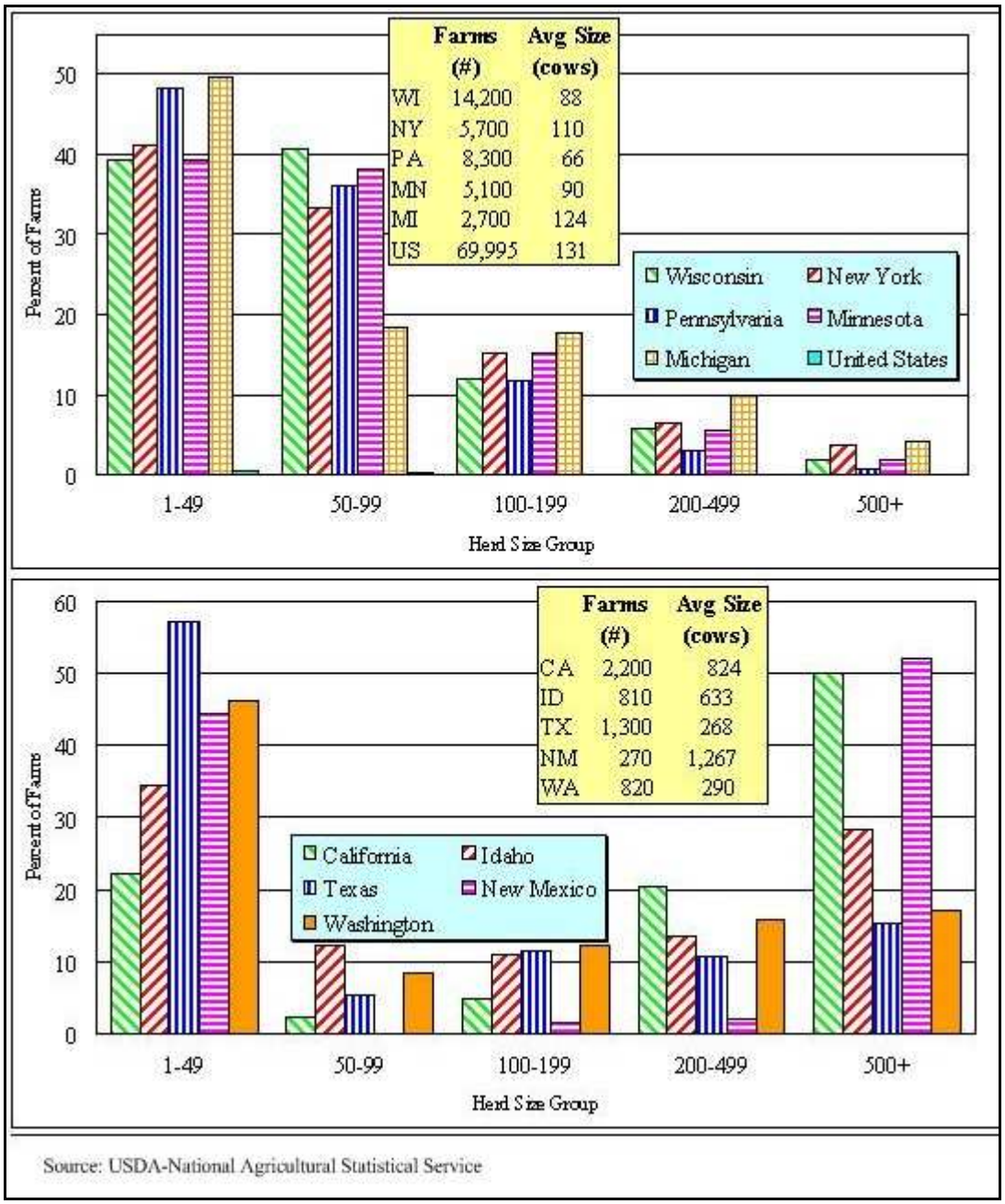

Figure 1. Distribution of Farms by Average Herd Size, Selected States, 2007

Between 1987 and 2007 the number of dairy farms in the United States decreased from 202,000 to 70,000 farms. In contrast to the decline in farm numbers, there has been a relatively constant increase in total U.S. milk production resulting from both the increase in average farm size and steady increase in yields. In 1980, 120.8 billion lbs of milk was produced. Total

production increased to 155.3 billion lbs in 1995, a 29% increase from 1980 and 189.3 billion lbs in 2009, a 22% increase from 1995.

Consolidation of Dairy Cooperatives

Dairy cooperatives have historically played an important role in the dairy industry. The importance of cooperatives as the source of marketed farm milk in the United States has increased over the last 50 years. For example, in 1957, less than 60% of U.S. milk was marketed by dairy cooperatives. By 2008, cooperatives accounted for 80% of U.S. marketed milk (Buske, 2009). There are significant regional differences in the importance of cooperatives as a milk source. For example, in 2007 approximately 75% of the farm milk marketed in the North Atlantic and Western regions originated from a dairy cooperative. In the West North Central Region, more than 97% of the milk was marketed by a cooperative (Ling, 2008, Figure 2).

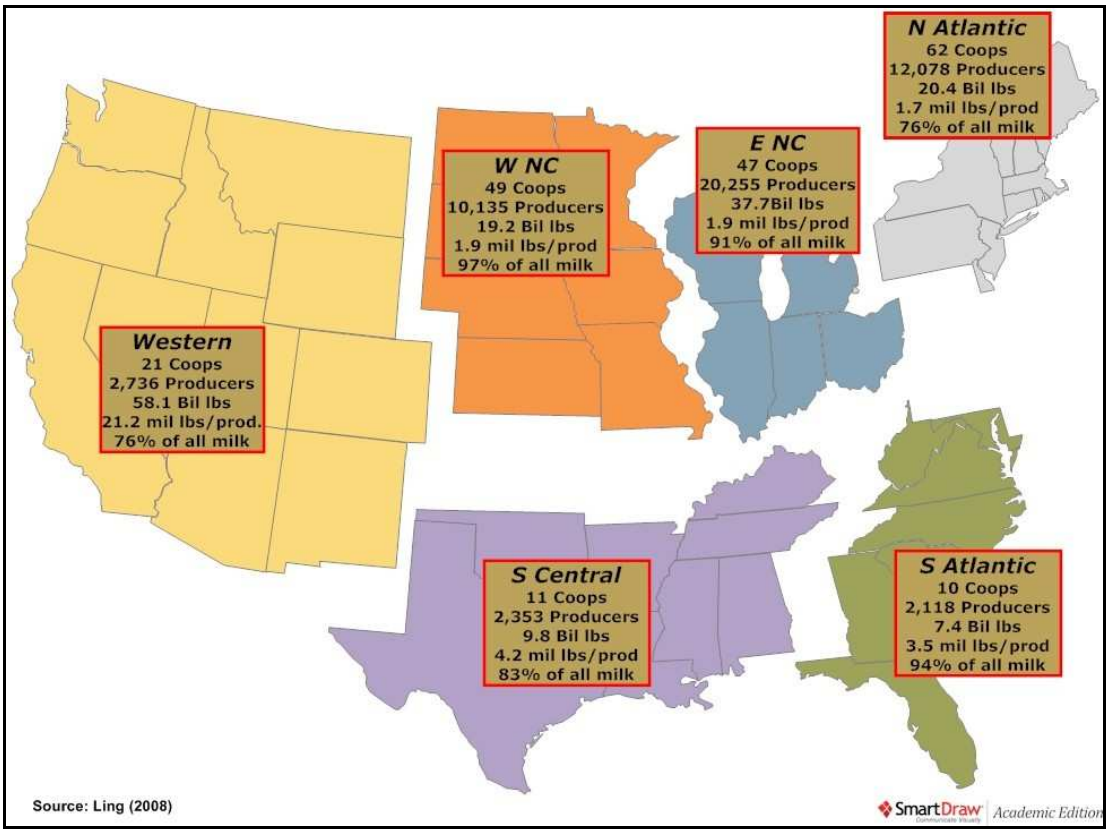

Figure 2. Regional Importance of Dairy Cooperatives in the Marketing of Farm Milk

Concurrent with the consolidation in the number of dairy farms, there has been significant consolidation of dairy cooperatives (Cropp, 2002). The evolution of cooperative mergers has moved from the creation of regional cooperatives in the 1960's and 1970's to multi-regional cooperatives such as Dairy Farmers of America formed in 1997 as a result of a merger of four regional cooperatives, AMPI-Southern region, Mid-America Dairyman, Inc (#2), Western Dairymen, Inc.(#14), and Milk Marketing, Inc. (#7) (GAO, 2001). In the year prior to the merger, these cooperatives accounted for 4.9% of the total value of sales of the 100 largest dairy processing firms and 21.1% of U.S. milk marketed. After merging, 18,543 farms were DFA cooperative members which represented 15% of U.S. farms and 26.2% of cooperative farms.

To quantify the degree of concentration in a particular industry economists have developed a number of measures. One measure of concentration is known as a *concentration ratio* (CR). For example, the CR4 is defined as the percent of the total industry's value of output represented by the four largest firms in that particular industry. A CR4 close to zero would indicate an extremely competitive industry since the four largest firms would not have any significant market share. In general, if the CR4 measure is less than about 40, then the industry is considered to be very competitive, with a number of other firms competing, but none owning a very large portion of the market.

We apply this measure to the market share of the 2, 4, 8, 10 and 20 largest dairy cooperatives with respect to the marketing of all U.S. farm milk (Figure 3). The major trend to obtain from these values is the pattern of increased market power of the largest cooperatives. The two largest cooperatives accounted for approximately 30% of U.S. milk marketed in 2008. This value was less than 20% in 1987. In 2008, the 10 largest cooperatives accounted for nearly 70%

of U.S. milk marketed compared to less than 50% in 1980. Using the critical CR4 of 40 as a guide, in 2008 the industry is just at the boundary of being considered very competitive. The above CR value should be considered in light of how one defines the extent of the market. The CR values reported here are national, but milk markets are regional in nature due to marketing order regulations and transportation costs. This implies that the regional CR values are likely to be much greater than the national values.

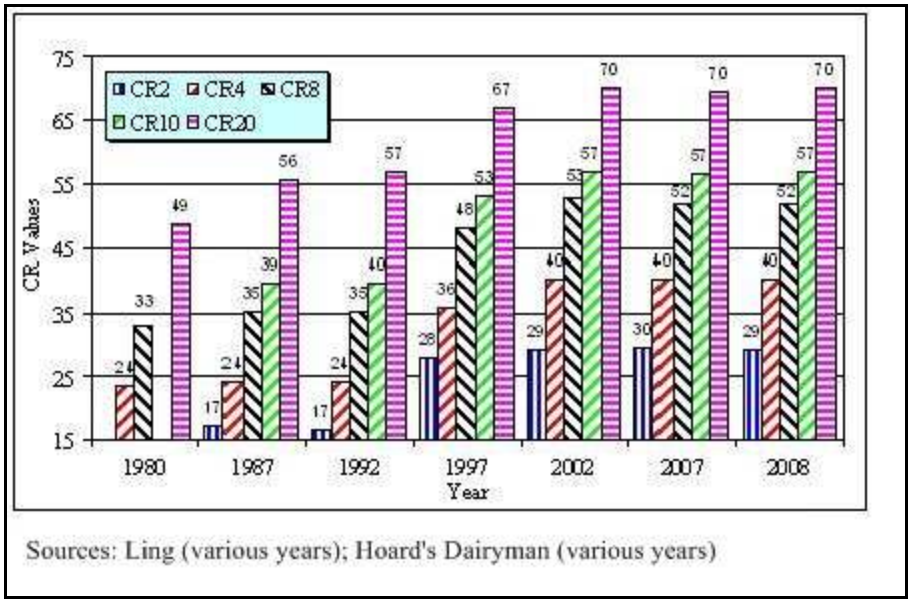

Figure 3. Cooperative CR Values of Total U.S. Milk Marketed

A second measure of industry concentration that has been developed by economists is known as the Herfindahl-Hirschman Index (HHI). Some believe that the HHI provides a more complete picture of industry concentration than does the CR statistic. The HHI uses the market shares of all the firms in the industry, and these market shares are squared in the calculation to place more weight on larger firms.

Unlike the CR value, the HHI will change if there is a shift in market share among the larger firms. Given the formulation of the HHI, if there were only one firm in the industry that firm would have 100% market share implying an HHI of 10,000 which is the monopoly HHI value. Alternatively, if there were a very large number of firms competing, each of which having

nearly zero market share, then the HHI would be close to zero, indicating nearly perfect competition. The U.S. Department of Justice (DOJ) uses the HHI in guidelines for evaluating mergers. An HHI of less than 1000 represents a relatively unconcentrated industry/market. The DOJ would usually not be concerned with a merger that leaves an industry with an HHI less than this value. The DOJ considers an HHI between 1000 and 1800 as representing a moderately concentrated market and the DOJ likely would closely evaluate the competitive impact of a merger that would result in an HHI in that range. Markets having an HHI greater than 1800 are considered to be highly concentrated. The DOJ considers a merger resulting in an HHI greater than this value as raising serious anti-trust concerns if the merger increases the HHI by more than 100 or 200 points.

Using the above HHI formula we examined the distribution of only milk marketed by cooperatives, in contrast to the CR values which were evaluated with respect to all farm milk produced in the United States.

Using data for the largest 50 cooperatives and the amount of farm milk marketed by all U.S. dairy cooperatives over the 1987-2008 period we obtained HHI values that increased from 472 in 1992 to 924.3 in 2008 (Figure 4). The 51st cooperative was an aggregate "other cooperative" representing all those not in the top 50. These cooperatives represented less than 4% of the milk marketed in 2008. The trend to observe from this figure is the significant increase between 1992 and 1997 due mainly to the creation of DFA in 1997.

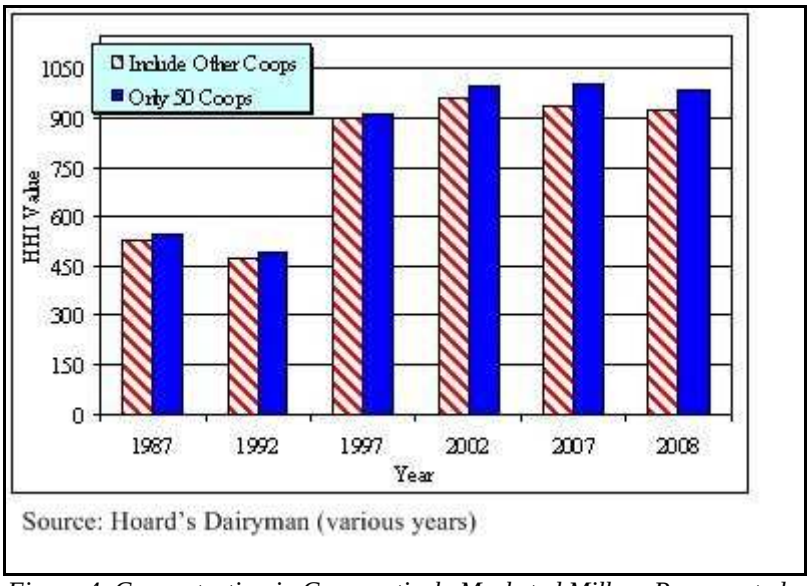

Figure 4. Concentration in Cooperatively Marketed Milk as Represented by the HHI

The increased concentration of dairy cooperatives has occurred for a variety of reasons. These reasons include: improve bargaining position for members, improve ability to integrate operations to achieve economies of scale and scope, tight operating margins and capital constraints, rapid increases in information technology and increase in volatility of milk prices since the late 1980's (GAO, 2001; Cropp 2002).

Consolidation in Dairy Manufacturing

Similar to the marketing of farm milk, there has been significant consolidation in dairy manufacturing. During the 1990's a dominant method to expand was via the purchasing of regional manufacturing firms. For example, over 1997-2000 more than 60 dairy processors were purchased by Suiza and Dean Foods. From its founding in 1993, Suiza Foods became the largest fluid milk bottler in seven years (Siebert et al, 2000). Dean Foods was founded in 1925 in northwestern Illinois. Prior to its merger with Suiza Foods in April 2001, it represented the third largest dairy processing firms defined by the value of dairy products sold resulting from acquisition of a number of dairy processors. Between 1997 and 2000, Suiza Foods had purchased

regional processing firms with a cumulative sales value at the time of acquisition of $3.3 billion while Dean Foods had purchased firms with a cumulative sales value of $1.6 billion (Dairy Foods, various issues; GAO, 2001). In Table 2 we show the importance of these two firms over1995-2000 in sales ranking. The combined company, under the Dean Foods name, processes 33% of the U.S. fluid milk and is included in the S&P 500 stock index.

Table 2. Share of the Value of Shipments by Top 100 Dairy Processors Represented by Dean Foods and Suiza

	Suiza		**Dean Foods**	
	$Mil Sales	**Rank**	**$Mil Sales**	**Rank**
1995	379	40	1,400	5
1996	469	32	1,600	2
1997	1,720	4	2,100	3
1998	2,820	3	3,000	2
1999	4,237	2	3,200	3
2000	5,365	1	3,255	3

Source: GAO, 2001

Figure 5 shows CR statistics with respect to the total value of dairy products sold by the top 100 U.S. dairy processing firms. In 2008, approximately 19% of the total value of dairy products produced in the United States was accounted for by the two largest dairy firms, Dean Foods and Kraft Foods-North America (Dudileck, 2009). Over 1995-2008, the top 20 firms increased their market share from 55% to 67%. These national values tend to hide concentration within local areas and commodities. Although dated, Table 3 is used to show the percentage of fluid milk marketed by the four largest dairy processors in various metropolitan areas over a number of years (GAO, 2001). With the trend observed at the national level since 2000, it is reasonable to assume that the 1999 values can be considered minimum CR4 values.

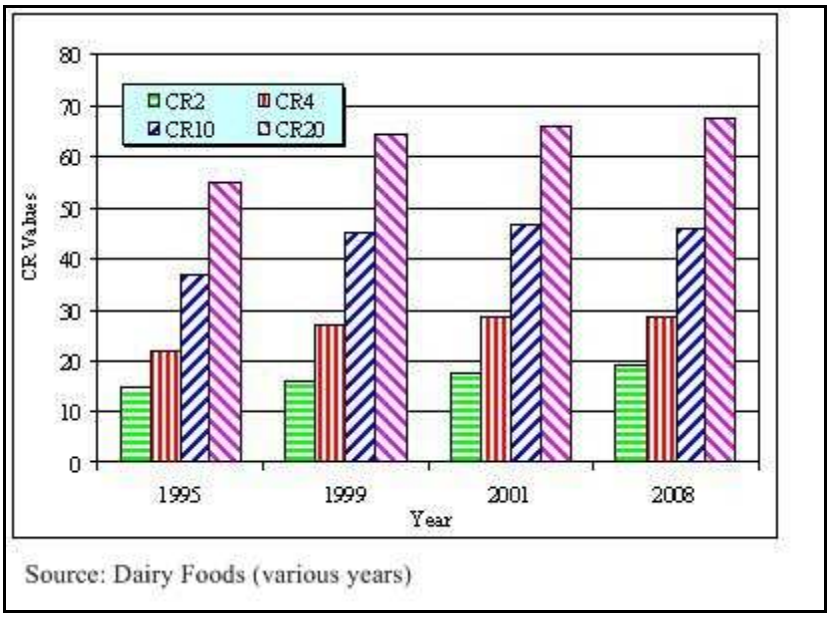

Figure 5. Concentration Ratios in Dairy Processing as Represented by CR Values

Table 3. Percentage of Fluid Milk Marketed by 4 Largest Processors Dec 1997–Dec 1999 by City

Area	Dec '97	Dec '98	Dec '99	Area	Dec '97	Dec '98	Dec '99
Atlanta	38.5	47.8	52.4	Atlanta	81.6	80.3	75.9
Boston	66.2	85.4	88.1	Boston	84	89.3	83.4
Charlotte	64.4	74.7	73.9	Charlotte	38.5	47.8	52.4
Cincinnati	66.8	79.3	81.9	Cincinnati	90.3	87.6	97.4
Dallas	85	84.3	79.4	Dallas	87.7	90.4	92.5
Denver	69.3	68.1	66.9	Denver	59	63.4	63.3
Miami	89.4	96.5	96.3	Miami	45.7	43.7	54.5
1999 U.S. CR4: 26.8				14-Market Avg.	69	74.2	75.6

Source: GAO, 2001

Similar to our calculation of the concentration in the marketing of cooperative milk, we evaluated HHI values using the above data. The HHI value is much less than 1000 but shows a similar trend of becoming increasingly concentrated. In 1995, the top 100 processors generated an HHI index of 238. This increased to 382 by 2008, well below the critical 1000 level. Again it should be cautioned that the regional HHI values are likely to be much larger than the national values given, especially for bottled milk due to a market size that is regional in nature.

Pricing of Farm Milk and Concentration Implications

A majority of the milk produced in the United States is marketed under Federal and State milk marketing orders. Typically under these marketing orders, minimum prices for milk are determined via a series of formulas which relate the farm value of milk components—for example: fat, protein, other solids—to their value reflected in recent wholesale commodity prices. Once the component values are known then the farm value of milk can be determined.

The formulas used often vary depending on how milk is utilized. Under the Federal Milk Marketing Order system which in 2009 accounted for two-thirds of the milk marketed in the U.S., there are four classes of milk: Class I (beverage products), Class II (soft manufactured products), Class III (hard cheese and cream cheeses) and Class IV (butter and non-fat dry milk). Class specific minimum prices based on component values are used to establish minimum milk class prices. As an example, the value of Class III milk is determined by monthly average wholesale prices of cheddar cheese, butter, and dry whey. These monthly average cheese prices are obtained from weekly surveys of national dairy product sales data by the National Agricultural Statistics Service (NASS). For a review of milk pricing under the FMMO system refer to Jesse and Cropp (2008)

The following provides an example of how the uniqueness of the dairy industry makes it susceptible to undue market power.

> "…Certain market conditions at the [Chicago Mercantile Exchange] spot cheese market continue to raise questions about the potential for price manipulation."
>
> [GAO report to Congress on the CME spot cheese market, June 2007, p. 1]
>
> "During the period May 21 through June 23, 2004, DFA, Hanman and Bos attempted to manipulate the price of the [CME] June, July and August 2004 Class

> III milk futures contract. DFA, Hanman and Bos attempted to manipulate Class III milk futures contract prices through purchases of cheddar cheese blocks on the CME Cheese Spot Call market in an effort to minimize potential losses from DFA's speculative long Class III milk futures positions" [Commodity Futures Trading CFTC Order, Dec. 16, 2008, p.2].

In 2008, DFA accounted for 20.1% of all farm milk deliveries in the United States (Buske, 2009). For a copy of the consent decree refer to the following URL: http://future.aae.wisc.edu/pubs/pubs/show/409. This case provides a clear example of how a thinly traded commodity, a large supplier of farm milk to the U.S. dairy industry, and a formula-based milk pricing system create an environment where market manipulation can occur.

Related to the above, are several important characteristics of the U.S. cheese manufacturing industry that greatly facilitated manipulation of the cheese price and therefore the announced Class III price. First, it is a standard industry practice for cheese manufactures to price their product based on movements in the CME spot cheddar cheese market. This can be seen in Figure 6 where we show the NASS average cheddar block price and the weekly average CME spot block price lagged by two weeks. Over 99% of the variability in the NASS average block price is explained by movements in the CME spot block market.

The CME spot market is a thinly traded market where typically less than 2% of monthly U.S. cheddar cheese production is traded in this spot market. In addition there are very few participants in this market, mainly large companies and cooperatives. As an example, over Jan. 1, 1999 – Feb 2, 2007 the largest two buyers of cheddar blocks accounted for 74% of the transactions. The largest two sellers of cheddar barrels accounted for 68% of the transactions. In addition, over this same period, a majority of the closing prices are determined by unfilled bids

and uncovered offers (GAO, 2007). During the period covered by the CFTC order DFA was one of these few participants.

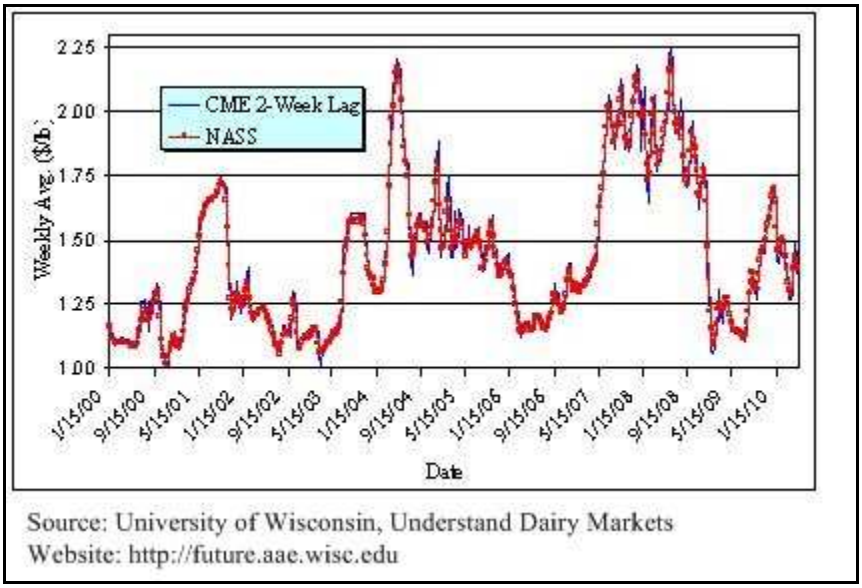

Figure 6. Relationship Between Weekly 2-Week Lagged CME Spot Cheddar Prices and NASS Average Cheddar Block Price

A second characteristic concerns the relationship between Class III futures contract settlement and the formula-based Class III milk price. The Class III futures contract is a cash-settle contract which means there is no delivery requirement associated with the purchase of a Class III futures contract.

Ongoing Industry Challenges

The dairy industry has had a history of significant structural change in the location, scale and number of participants. These changes are continuing to occur as a result of improved technologies at both the farm and processing levels, increased energy costs and increased milk price volatility.

There are a number of challenges facing the industry. It has been industry practice to use the CME spot price of cheese as a benchmark by which plants determine their sales price. This is a problem, given that this market has few participants and those participating undertake a limited

number of transactions. The question remains as to how the industry can move away from this reliance (Carstensen, 2010). There is considerable industry debate concerning elimination of the current formula based pricing system for farm milk to one based on plant surveys of prices paid for manufacturing milk instead of wholesale commodity prices.

There are local areas across the United States where a single dairy cooperative that markets a significant percentage of farm milk has entered into supply agreements with fluid milk bottlers that service a majority of local retail food establishments. Given the expected continued concentration of the marketing of farm milk, processing of that milk and retail distribution such arrangements are expected to become more common and thus requiring continued monitoring by the appropriate anti-trust and regulatory officials (Flagg, 2010; Carstensen, 2010).

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Milk Marketing Orders: Who Wins and Who Loses?

Hayley Chouinard, David E. Davis, Jeffrey LaFrance, and Jeffrey M. Perloff
JEL Classifications: Q13, Q18

Federal milk marketing orders (FMMO) raise prices of fluid milk products and lower the prices of manufactured dairy products such as cheese and ice cream. What effect do these prices changes have on the well-being of various groups of consumers? Do the federal milk marketing orders favor the rich over the poor? We use data from retail sales to answer these questions.

The milk market is not a textbook competitive industry. Over the years, it has been affected by dairy price support programs, import quotas on dairy products, and the FMMO. For several decades, the supports, quotas, and marketing orders jointly determined farm, wholesale, and retail prices for processed fluid milk and manufactured products. We look at a period, 1997-1999, when milk marketing orders were the main policy affecting dairy markets.

Milk Marketing Orders

Many states are covered by the federal milk marketing order system. Four states have their own milk marketing orders; however, only Virginia's and California's orders completely replace federal orders. The most striking feature of milk marketing regulations is they allow the industry to engage in classified pricing, where milk used in various products sells for different prices. During the period we studied, separate prices were set for Class I milk used in fluid beverage products; Class II milk used in soft dairy products such as ice cream, cottage cheese, and yogurt; Class III milk used in hard dairy products such as butter and cheese; and Class III–A milk used

to manufacture nonfat dry milk. By allowing the industry to set different prices for various uses, the milk marketing orders essentially allows the industry to price discriminate. Were it not for the FMMO, all milk would sell for a single price at the farm-level.

The Federal Agriculture Improvement and Reform Act of 1996 mandated reforms to the FMMO program, changing how the minimum prices paid to farmers were determined. We study the transition period, 1997-1999, immediately following the passage of this law.

Empirical Study

To determine the effects of the marketing orders on consumers, we need to determine how consumers change their consumption of milk products in response to price changes. To do that, we estimated how the quantities of these goods demanded by consumers vary with prices, taking account of city-level demographic variables: ethnicity, home ownership, employment status, occupation, age and number of children in the household, education and age of household heads, and income (Chouinard et al., 2010). The estimating model uses Information Resources, Incorporated retail grocery scanner data of weekly city–level purchases of dairy products matched with demographic characteristics of the purchasing households in 22 cities, where we adjusted the prices for taxes.

We simultaneously estimated demand functions for 14 dairy products: milk (non–fat, 1% milk, 2% milk, whole), cream/creamers (dairy cream, including half and half, and coffee creamers); spreads (butter and margarine); ice cream (including frozen yogurt and ice milk); yogurt (cooking, divided into plain and vanilla yogurt, and flavored); and cheese (cream cheese, shredded and grated, American and other processed cheese, and natural). The demand functions show how the quantity demanded varies as the retail prices of the various dairy products change for various demographic groups.

We find—not surprisingly—that whole milk, 2%, 1%, and nonfat milk are close substitutes. That is, if the relative prices change slightly, consumers will switch from the now relatively expensive milk to the now relatively cheap one. Although this result is intuitively appealing, earlier studies that failed to subdivide milk products as finely as we do failed to find it.

Removing the FMMO would affect farm prices. LaFrance (1993), Cox and Chavas (2001), and Kawaguchi, Suzuki, and Kaiser (2003) estimated that the lower farm prices for fluid milk would lower retail fluid milk prices proportionally. These same studies find that the degree to which the increase in milk prices for manufactured milk products would be passed on to retail products varies by product, and their estimates differ slightly.

Here, we used the average of their estimated retail price responses and our demand system estimates to simulate how removing the FMMO would change the quantities of dairy products demanded in response to price changes. Chouinard et al., 2010, simulated other possible retail price change scenarios as well.

Next, we calculated how much consumers are harmed by a price increase or helped by a price cut using the measure of well-being that economists call equivalent variation. The equivalent variation for a price increase is the amount of income that, if taken from the consumer, harms the consumer by as much as the price increase. Thus, if the equivalent variation is negative, then consumers are worse off after the price changes. We calculated the equivalent variation of milk marketing orders for various demographic groups.

Table 1 shows how the price and quantity demanded change on average across demographic groups for each dairy product when the federal milk marketing orders are eliminated. Because milk prices would fall by 15.5%, the purchased quantities of 1%, 2%, non–

fat, and whole milk increase substantially. Because the prices rise for some manufactured products, the corresponding purchased quantities of these products fall, but by comparatively modest amounts.

Table 1. Estimated Percent Change in Price and the Resulting Average Percentage Change in Quantity from Eliminating the Federal Milk Marketing Orders

Food	Price	Quantity
1% Milk	–15.5	25.0
2 % Milk	–15.5	9.5
Nonfat Milk	–15.5	7.4
Whole Milk	–15.5	6.8
Fresh Cream	1.3	0.8
Coffee Additives	1.3	1.1
Natural Cheese	0.5	0.2
Processed Cheese	0.5	0.5
Shredded Cheese	0.5	0.5
Cream Cheese	0.5	–1.1
Butter	–3.0	–0.3
Ice Cream	–1.0	1.9
Cooking Yogurt	1.3	–4.2
Flavored Yogurt	1.3	–1.0

Source: Chouinard et al. (2010) based on Information Resources, Incorporated retail grocery scanner data.

Given the estimated changes in the purchased quantities of fresh fluid milk and manufactured dairy products in the scenarios when all dairy prices change, we expect some dairy consumers to benefit and others to lose. Table 2 shows the simulated equivalent variation effects, in dollars per week, across several demographic groups when we hold all but the specified demographic variable fixed at their sample means. All but the wealthiest consumers would benefit from eliminating the FMMO—that is, their equivalent variation is positive.

The first row of Table 2 shows that the price changes from removing the FMMO would help the average household by the same amount as giving them an extra $2.94 per week. The

next two rows show that the equivalent variation is $2.96 for a white household and $2.10 for a nonwhite household.

Table 2. Equivalent Variation ($/week) for Various Demographic Groups from Eliminating the Federal Milk Marketing Orders

Group	Equivalent Variation
Mean	2.94
White	2.96
Nonwhite	2.10
Income=$10,000	3.84
Income=$30,000	2.63
Income=$50,000	1.41
Income=$70,000	0.20
Income=$90,000	–0.92
Education=10 Years	1.95
Education=16 Years	3.62
Young Child (0–5.9)	3.88
Middle Child (6–11.9)	1.65
Older Child (12–18)	2.57
No Children	2.83
Family with 3 Children[a]	5.77
Childless Couple[b]	3.34

a The heads of household are 35 years old, they have a real income of $20,000, the wife is not employed, the husband works in a nonprofessional occupation, they have three children under six years of age, and they rent their dwelling.

b The heads of household are 30 years old, they have a real income of $60,000, both are working professionals, and they own their dwelling.

That the welfare effects of changes in dairy product prices vary with the race of the household may be due to varying incidences of lactose intolerance. In the United States, the occurrence of lactose intolerance (nutrigenomics.ucdavis.edu) is, at 5%, relatively low for Caucasians of northern European and Scandinavian descent—although it spikes to 70% for North American Jews. Lactose intolerance is much higher for other ethnicities: 45% for African American

children and 79% for African American adults, 55% for Mexican American males, and 90% for Asian Americans—98% for those from Southeast Asia.

Not surprisingly, families with children younger than six years of age that consume large quantities of milk have a much larger benefit, $3.88 per week, than families with no children, $2.83. The equivalent variation falls with income from $3.84 for the poorest households with incomes less than $10,000, to -$0.92 for households with incomes of over $90,000. Consequently, as the next to last row shows, a family with a relatively low income of $20,000 and three children under the age of six that rents its dwelling, benefits substantially, $5.77, from eliminating federal milk marketing orders.

Finally, our simulations show that FMMO regulations are highly regressive. We define the regulatory burden of the FMMO program as a household's annual equivalent variation from removing the marketing orders divided by its annual income. That is, the regulatory burden is the share by which a family's effective income would rise from eliminating the federal marketing orders.

Figure 1 compares the regulatory burden as a function of income for white and nonwhite families. The equivalent variation of removing the marketing order is positive at low incomes—consumers benefit from removing it—so there is a regulatory burden (loss) from imposing the federal marketing orders for milk. For white families, the burden falls from 0.61% at an income of $7,500, to 0.44% at $10,000, 0.19% at $20,000, 0.11% at $30,000, 0.04% at $50,000, and 0.01% at $75,000. At higher incomes, the burden is slightly negative, ranging from –0.002% at $85,000 to –0.04% at $200,000.

The curve for nonwhite families lies strictly below that for white families, although both curves fall with income. At $7,500, the regulatory burden of a nonwhite family is about half that

of a white family. At the average real income, $25,000, the regulatory burden is about one-third for the nonwhite family as for a white one. Perhaps this difference has to do with higher rates of lactose intolerance among nonwhites.

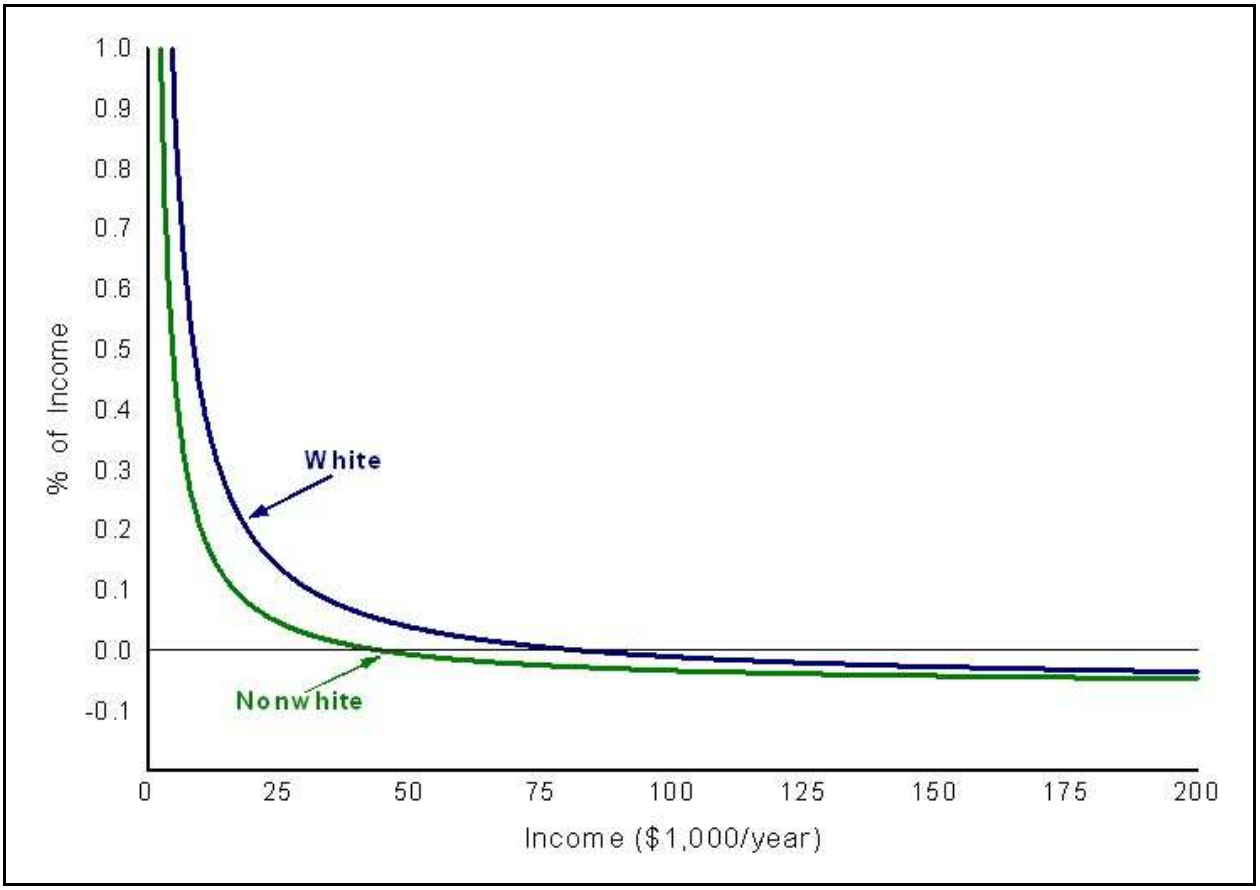

Figure 1. Regulatory Burden of the FMMO

Competition and Antitrust

As this set of articles concerns competition and antitrust, we briefly examine how marketing orders affect competition. During the Great Depression when dairy marketing orders were first instituted, some people justified them as a response to bottling plant monopsony—a single buyer—or oligopsony—a small number of buyers. Even if that was once true, this justification is no longer plausible. Moreover, ameliorating the problems of monopsony by imposing costs on

consumers cannot be the optimal response. As the FMMOs raise the average price to consumers, they effectively create the same harm as a monopoly or oligopoly.

Conclusions

The federal milk marketing orders raise the retail prices of fluid milk products and lower the prices of some manufactured dairy products, raising the average price of milk across all dairy products. The loss from the federal milk marketing orders is equivalent to a loss of income of $2.94 per week for the average household, or $152.88 per year. Given that there are roughly 100 million U.S. households that buy dairy products, the total harm to society is approximately $15.3 billion. Thus, the federal milk marketing orders disproportionately harm the poorest members of society—the proverbial widows and orphans—by raising fluid milk prices, and benefit the richest by lowering the prices of such goods as triple cream cheeses.

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Grocery Retailers' Dominant Role in Evolving World Food Markets

Richard J. Sexton
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The major structural changes influencing world agricultural markets include increasing consolidation and market domination by large processing, trading, and retailing firms, disappearance of traditional auction or spot markets for exchange of farm products and their replacement by various forms of contracts and vertical control, and a growing emphasis on product differentiation and increasingly broad dimensions of product and selling-firm quality. None of these changes is consistent with the tenets of traditional models of competitive agricultural markets.

Despite consolidation throughout the food market system, grocery retailers, oftentimes with international scope, have emerged as the dominant players in the food chain in most parts of the world. These retailers through marketing contracts exercise considerable vertical market control over upstream suppliers in terms of varieties produced, inputs utilized, production schedules, etc. Yet we know little about grocery retailer pricing and promotion strategies or how these strategies affect both the level and variability of prices at the farm level. This paper describes these key trends and their implications for farmer welfare and the analysis of agricultural markets.

Key Forces Shaping World Agricultural Markets

Rising Concentration and Consolidation Worldwide

The food industry is highly concentrated in most developed countries at both the retail and processing stages, and concentration is rising over time (Sexton, 2000; Kaufman, 2000; Rogers, 2001; Dobson, Waterson, and Davies, 2003). Mergers and acquisitions have been a major factor contributing to increasing concentration. However, ability to track these trends has been diminished by reduced data collection at national levels, so in many cases the most recent statistics are quite dated.

Concentration in food retailing has risen rapidly in developing countries due to the supermarket revolution that began in the larger cities of richer Latin American countries and then quickly spread to smaller cities and poorer countries on the continent. By 2000, the supermarket share of retail sales in Latin America was in the range of 50-60%, only slightly less than the 70-80% share attained in the United States over several decades. East and Southeast Asia experienced a similar diffusion, although beginning several years later than in Latin America. Africa is the most recent front in the global development of retail chains, with South Africa at the forefront, where Reardon et al. (2003) reported a 55% supermarket share of all retail food sales. Particularly noteworthy from the perspective of power in the global food market is that much of this growth has been accomplished by the large, international grocery chains, in particular, Wal-Mart, Carrefour, and Royal Ahold, although smaller multinationals and regional chains have also played a key role (Reardon et al., 2003).

Increasing Emphasis on Many Dimensions of Product and Firm Quality

The term “quality” can refer to many dimensions of a food product including traditional attributes such as taste, appearance, convenience, brand appeal, and healthfulness, but also to broader dimensions such as characteristics of the production process—usage of chemicals,

sustainability, physical location, or confinement conditions of animals—and implications of production and consumption of the product for the environment.

Product quality in all of its dimensions is critical in modern food markets. Numerous studies have documented consumers' willingness to pay premiums for food products that satisfy the quality dimensions that are important to them. Most of these studies are focused on developed-country consumers, but, given the emergence of high-value export chains in developing countries, the issues resonate there as well. Given the great heterogeneity among consumers in what food product attributes matter to them, considerable opportunities exist for product differentiation and exploitation of market niches.

Of course, most firms do not sell directly to consumers, but instead sell to market intermediaries who transmit information regarding consumer demands upstream toward producers and also introduce additional considerations relating to their own preferences. As downstream buyers, especially retailers, have become increasingly powerful, transactions in the food sector have become more complex, involving more than the mere transfer of a food product. Thus, a second dimension of "quality" pertaining to the attributes of the firm producing and/or marketing the product has come to matter in modern, vertically coordinated market chains in terms of the firm's abilities to satisfy the characteristics in a supplier sought by downstream buyers. These include ability to provide product reliably year around and in volumes necessary to meet demand; provide ancillary services, such as category management, third-party product-safety certification, and electronic data interchange; and supply products across a category of food items.

The ability to meet many of the characteristics sought by grocery retailers relates at least indirectly to size or scale of the seller, a fact which helps to explain the steady trend towards

increasing firm size and concentration in the food marketing sector. However, when the desired quality characteristics of the food products themselves are considered, opportunities are created for well-positioned, small firms to exploit market niches.

Vertical Coordination and Control

Vertical coordination and control and the use of production and marketing contracts is difficult to measure in a quantitative way because the extent of vertical relationships exists on a continuum, ranging from essentially none in open-market transactions to complete control in the case of vertical integration. Although contracts have been widely used in agriculture for a long time, their incidence is increasing and extending to the developing world and, further, the amount of control exercised is increasing, in large part due to the market's increasing demand for multifaceted product quality.

Contracts are a device to surmount the information problems that can lead to lower product quality. By actually controlling use of key inputs, including their application, downstream firms prevent problems from misalignment of incentives that could otherwise diminish product quality and increase food safety issues. Contracts can also specify quality standards and thereby address adverse selection problems that might be caused by failure of the open market to adequately recognize and reward quality.

Thus, there is little doubt that contract production can improve market efficiency and align production with the demands of the market for particular quality attributes. Contracts, however, may also be a device to consolidate buyer market power, and they may result in the exclusion of the smallest producers, leading to further consolidation at the farm sector.

This latter issue is especially important in developing countries and is a topic of considerable debate and on-going research. Concomitant with the development of high-value

export chains in these countries is the upsurge of contract production to insure the quality attributes desired by consumers in the European Union (EU) and United States. Is the growth of these markets providing opportunities to improve smallholder welfare, or does contract production and vertical integration by exporters cause the smallest and poorest farmers to be excluded?

Grocery Retailer Power and Farmer Welfare

High concentration among food retailers raises legitimate concerns about retailers' ability to influence prices charged to consumers through exercise of oligopoly power by a few dominant sellers, and prices paid to suppliers through exertion of oligopsony power by a few dominant buyers. Consumers are distributed geographically and incur nontrivial transaction costs in traveling to and from stores. The relevant geographic markets for assessing retailer market power are local in scope, making grocery retailing a "natural oligopoly" in the words of Ellickson (2007). Further, as grocery stores become larger in both their physical dimensions and the number of products they carry, there will be fewer of them in a given geographical area, exacerbating the spatial oligopoly aspect. Retailer oligopoly power is also likely to be an important consideration in developing countries due to the generally poor transportation infrastructure, and, hence, high transportation costs, that exist in these locations.

Of course, an argument can be made that consumers benefit on net from the food-retailing revolution due to lower prices caused by economies of size and scope generated by large chains and by the access they offer to a vast array of products. The best empirical evidence on this point is several studies that show Wal-Mart sets prices lower than conventional retailers, and, moreover, induces a "yardstick of competition" effect by causing conventional supermarkets who compete in close proximity to Wal-Mart to charge lower prices.

On the procurement side, large food manufacturers with prominent brands may be able to countervail retailer buying power, but grower-shippers when they sell directly to retailers and also private-label manufacturers lack similar bargaining power. The imbalance of bargaining power is exacerbated in industries where the farm product is highly perishable because grower-shippers cannot access outside selling opportunities or defer sale through storage in hopes of attracting a better price. High transportation costs relative to product value for many commodities mean that procurement markets are local or regional in geographic scope, making market definition a critical component of any analysis of oligopsony power in food markets.

What are the consequences of retailer market power for the welfare of farmers? A first basic point is that either oligopoly power or oligopsony power is detrimental to farmers because either causes diminished sales of the farm product, and, since farm price in all cases is determined at the intersection of total sales volume with the farm supply curve, any sales-reducing market power reduces farm price along a normal upward-sloping supply curve.

However, things are more complex than this simple analysis would suggest due to the ways in which modern retailers set their prices. I present three observations about grocery retailer pricing and the link between prices at farm and retail. Empirical support for these observations abounds, but is mainly based on analysis of retailing data for the United States and EU and is summarized in Sexton, Zhang and Chalfant (2003) and Li, Sexton, and Xia (2006). Jointly these factors cause the farm and retail prices nowadays to bear little relationship even for basic produce commodities, so a traditional model specifying retail price as a simple mark-up function of the farm price has almost no predictive power.

- Observation 1: Prices across retailers in a given city or region for a given commodity exhibit wide dispersion and low correlation.

- *Observation 2*: Retail price changes are at most loosely related to price changes for the farm commodity, and thus acquisition costs play a comparatively minor role in the retail pricing decision.
- *Observation 3*: Transmission of farm price changes to retail is (a) delayed, (b) incomplete, and (c) asymmetric.

Table 1. Shipping-Point and Retail Price Correlations for California Hass Avocados—Los Angeles-Area Chains

	LA-1-L	**LA-1-S**	**LA-2-L**	**LA-2-S**	**LA-3-L**	**LA-3-S**	**LA-4-L**	**LA-5-L**	**LA-5-S**
LA1-L	1								
LA1-S	0.53	1							
LA2-L	0.31	0.16	1						
LA2-S	0.09	0.11	0.19	1					
LA3-L	0.12	0.32	0.16	0.01	1				
LA3-S	-0.09	0.3	0.04	0.35	0.33	1			
LA4-L	-0.2	0.32	0.43	0.09	0.17	-0.05	1		
LA5-L	0.51	0.55	0.31	0.24	0.22	0.38	0.34	1	
LA5-S	0.31	-0.15	0.23	0.02	0.08	-0.26	0.25	0.04	1
Shipping-L	0.13	0.27	0.13	0.34	0.14	0.13	0.36	0.35	0.32
Shipping-L-1	0.16	0.29	0.15	0.33	0.17	0.15	0.34	0.35	0.31
Shipping-S	0.28	0.35	0.26	0.45	0.1	0.16	0.4	0.43	0.35
Shipping-S-1	0.28	0.38	0.27	0.48	0.12	0.18	0.34	0.44	0.33

Notes: LAi-L (LAi-S) denotes large (small) avocados sold at retail chain i (i = 1,…,5) in Los Angeles; shipping-L and shipping-L-1 denote contemporaneous and one-week lagged shipping-point prices for large avocados shipped to Los Angeles, respectively.

An illustration of observations 1 and 2 is provided in table 1 for Los Angeles area grocery chains for Hass avocados. The example is chosen because the Hass avocado is a primary agricultural product that is produced in close proximity to Los Angeles and undergoes little "processing" in moving from farm to retail, meaning that factors intervening between the farm and retail price are relatively limited. Yet we see that the correlations of prices among the Los Angeles retailers are very low and in some cases negative, as are the correlations between the shipping-point price for Los Angeles area shipments and the various retail prices.

A model of competitive food retailers and simple, cost-based margins cannot explain any of these outcomes. Under perfect competition product prices for stores within a city should be highly correlated with each other and also with the price for the farm commodity. Under competitive retailing, price changes at the farm transmit fully and quickly, based upon shipping time, to retail.

However, these observations are also mostly inconsistent with traditional models of market power and single-product sellers. Without question a key but little understood factor in grocery retailer pricing and marketing strategies is the multiproduct nature of food retailing. Modern U.S. supermarkets supply 40,000 or more distinct product codes and use a variety of strategies to differentiate themselves from their competitors.

Models of unilateral seller market power can explain retail prices that respond only partially, or in extreme cases not at all, to changes in price at the farm level. Partial absorption of a farm price increase can represent the outcome of balancing the marginal impact of a lower profit per unit from not fully transmitting the cost shock with lower profit from reduced sales if the cost shock is transmitted fully.

Price rigidity can also be explained by repricing or menu costs within a competitive market framework, or by some retailers' use of everyday-low-pricing as an overarching marketing strategy in a differentiated oligopoly framework. However, menu and other costs associated with adjusting prices should cause prices to not change at all in response to minor shocks and to adjust fully to major shocks. The empirical evidence showing partial adjustment to shocks in the farm price is consistent with a market-power model, but not an adjustment-cost model.

How Does Retailers' Pricing Behavior Affect the Farm Product Market?

Retailer market power, by reducing purchases and sales, causes lower prices at the farm gate. However, retail prices that adjust only partially, or not at all, to shocks in the farm market are also harmful to farmers, tending to reduce average farm income and increase its variability. The fundamental point is that, if some share of the final sellers of a commodity stabilize price relative to market conditions and thus only partially transmit farm price changes or pursue pricing policies unrelated to market conditions at the farm level, then final price must fluctuate more widely for all other sellers, in order for the market to clear. Marginal revenues are, thus, not equated across the alternative outlets selling the farm product, decreasing total revenue available from a given level of production. In addition to the potential farm income loss, retailers' pricing strategies increase the volatility and riskiness of farm income compared to the baseline mark-up pricing case, further reducing the welfare of risk-averse farmers.

Implications for Agricultural Market Analysis

Are our traditional competitive models of agricultural markets capable of usefully analyzing modern markets and the forces discussed in this paper? The conclusion based upon my work in recent years, conducted jointly with various colleagues and current and former students, is that for many important questions even modest departures from perfect competition, such as the presence of relatively weak oligopoly or oligopsony power, are sufficient to lead analysis based upon the competitive model to severely biased conclusions.

Some summary observations are as follows:

- Efficiency losses from modest departures from competition in the food-marketing sector are minor (Sexton, 2000). This point is well known, and can be seen intuitively by visualizing the basic deadweight loss triangle—the economic loss from failure to produce

and consume the economically efficient amount. For a small departure from competition, this triangle is small—in the limit infinitesimally small.

- The deadweight loss increases at an increasing rate, so if market power is severe or is exercised at multiple stages along the market chain (Sexton et al. 2007), deadweight losses become large and consequential, approaching upwards of 25% of the total market surplus—benefit from consuming the product over and above the costs of producing it—that would be available under perfect competition.
- The efficiency consequences of oligopoly power are relatively greater than the consequences of oligopsony power for a given level of market power, other factors constant. Oligopsony power matters to market efficiency only to the extent that the farm input matters as a factor in producing the final product. In the United States for example, the aggregate farm share as a fraction of the food retail dollar is now less than 20%, making oligopsony power quite inconsequential as a source of overall economic inefficiency.
- The distributional consequences of market power are much greater than the pure efficiency consequences. The profits earned by the marketing sector represent a rectangle with height equal to the retail price minus farm price and marketing costs and width equal to the market output. Any market power that causes output to decrease even slightly raises price to consumers and reduces price to farmers, expanding the height of the entire rectangle and generating concomitant reductions in consumer and producer surplus. This point is of considerable importance because much of our market analysis is policy oriented, with specific policies designed to help farmers and oftentimes also poor consumers.

- Market intermediaries with even rather modest amounts of market power can capture large shares of the benefits from policies intended to benefit farmers. Sexton et al. (2007) demonstrate this point for tariff reductions by developed countries, considered a key strategy to improve developing country welfare. Downstream entities with market power, such as trading companies and retailers, were shown to capture the lion's share of the benefits from tariff reduction, especially when both oligopoly and oligopsony power were exercised or if market power were exercised at successive stages in the market chain.
- Farmer investment decisions are distorted by the presence of market power. Production decisions are of course distorted by market power, but this distortion will be small for modest levels of market power. However, it is the much larger distributional consequences of market power that influence incentives to invest because downstream market intermediaries with market power will capture a large share of the benefits of such investments.
- Accepted "wisdom" regarding agricultural policies based upon analysis of competitive markets may not be true for imperfectly competitive markets. One example is the commonly perceived pro-development impacts of trade liberalization already discussed. Another regards decoupled agricultural income support programs, which need not improve welfare relative to price floor or deficiency payment programs when downstream markets are imperfectly competitive (Russo, 2008). By fixing a minimum farm price outside of the market process these policies restrict downstream buyers' ability to exert oligopsony power. Thus, coupled support policies can, depending upon where minimum support prices are set, have a precompetitive and welfare-enhancing effect that is usually not considered when evaluating alternative policies.

The Bottom Line

Agricultural markets throughout the world have undergone a rather dramatic transformation marked by consolidation and market domination by large processing, trading, and retailing firms, disappearance of traditional auction or spot markets for exchange of farm products and their replacement by various forms of contracts and vertical control, and a growing emphasis on product differentiation and increasingly broad dimensions of product and firm quality.

Large international grocery retail chains have emerged through this process as the dominant players in the food system. Despite their unquestionably important role in the food system, we know rather little about retailers' behavior in terms of choices of products and brands carried, pricing strategies, and strategies concerning sales and promotions. Although consumers likely have benefitted from cost-reducing efficiencies introduced into the market chain and the entry of discount retailers, the impact on producers, especially small-scale producers, is probably less favorable. There is little evidence that the efficiencies generated by streamlining and coordinating food marketing through vertical control have contributed to higher prices at the farm level, as would be predicted in a competitive model of a vertical market chain.

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Pricing Power by Supermarket Retailers: A Ghost in the Machine?

Timothy J. Richards and Geoffrey Pofahl
JEL Classifications: L13, L66, Q13

During periods of rising prices, consumers, policymakers and media reporters alike tend to place the blame on food retailers (Boyle, 2009). Retail stores represent the final stop for most products on their way through manufacturers, distributors, brokers and wholesalers, so it is perhaps understandable why consumers tend to associate higher prices with profiteering, price-gouging and other nefarious conduct by retailers. Witness the well-publicized attempts to "cure" inflation in Zimbabwe and Venezuela by directly controlling retail prices, or the retailers themselves. Retailers represent a particularly easy target (no pun intended) because of their visibility and ubiquity. Indeed, the largest firm in the United States also happens to be the largest retailer—Wal-Mart Stores, Inc.

It is not hard to understand, therefore, why retailers are often asked to explain why they are not trying harder to keep prices down, and why they need to be so big. Whether the perception that retailers possess excessive pricing power is consistent with reality, however, remains an important academic question. In this article, we review the existing literature on market power in food retailing, and describe an empirical framework necessary to provide a definitive answer to this question, if indeed one exists.

The Food Retailing Industry

Implicit in all of these accusations is a presumption that retailers have market power, or the ability to set prices above marginal cost. Retail market power has been the subject of a considerable amount of research in economics, agricultural economics and marketing at least since the 1970s following our first experience with real food price inflation. Most of the early research was conducted within the structure-conduct-performance (SCP) paradigm, or the presumption that pricing, profitability and welfare outcomes were determined by market structure—level of concentration among firms in an industry.

On the surface, retail food markets appear to be highly concentrated. Although concentration ratios—as measured by the four-firm concentration ratio, or CR4, which is defined as the sum of the market shares of the top four firms—the national market are only about 50% (figure 1), food markets are local.

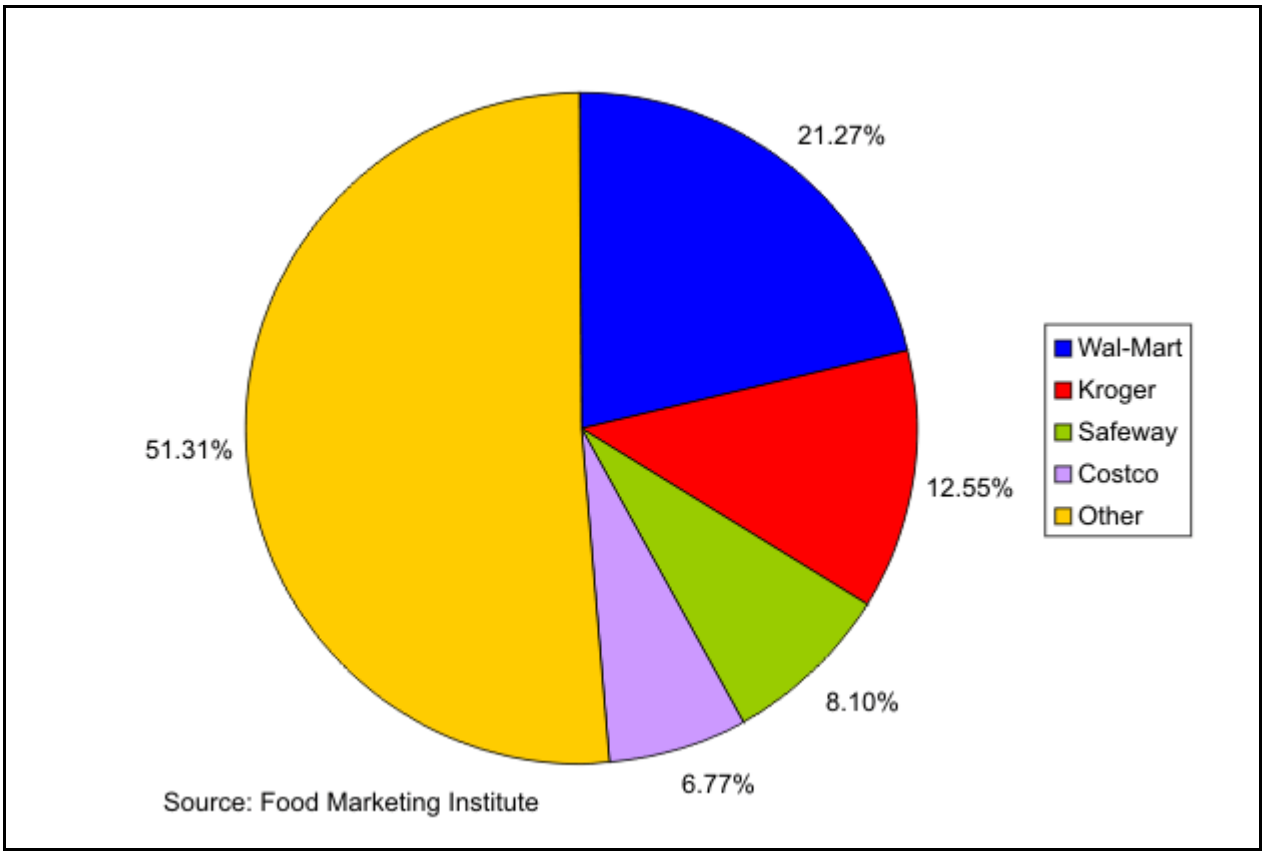

Figure 1. National Market Shares of Top Four Supermarkets: 2008

In some local markets, the CR4 is above 80%—a figure that typically would incite concern among Federal Trade Commission or Department of Justice officials (figure 2). Dobson, et al. (1999) compare supermarket concentration ratios between the U.K., European Union (EU) and the United States and note an apparent correlation with retail food prices. By 1996, the CR5 for UK supermarkets was already 64% while the CR4—the nearest comparable figure—was 23.2% in the United States (Franklin, 2001). Constructing a comparable basket of groceries in the UK and the United States, they find that if the basket cost $100 in the U.K., it would cost only $69 in the United States. While only indirect and partial evidence, it is suggestive of some sort of relationship between concentration and retail prices.

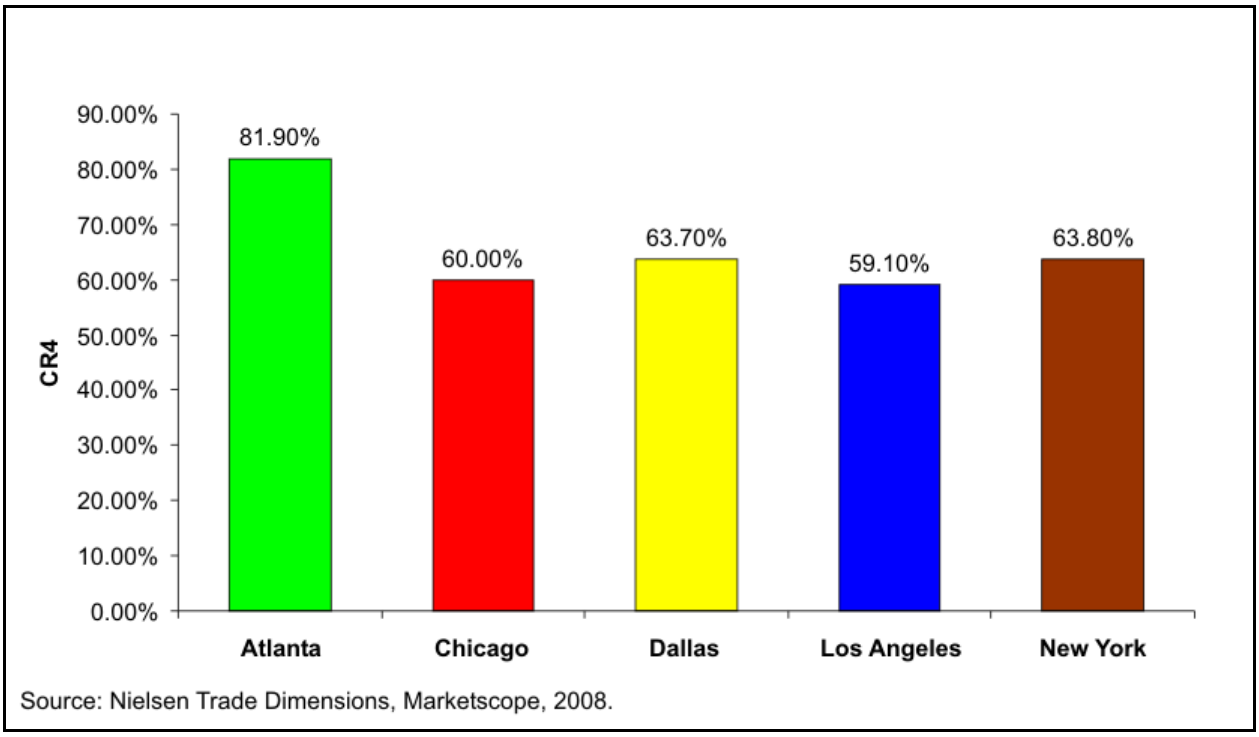

Figure 2. Retail Supermarket CR4 in 5 U.S. Markets: 2007

Concentration does not necessarily imply market power. Gross margin, defined as operating income as a percentage of sales, is often used as an indicator of profitability. By this measure, figure 3 shows that grocery retailers have become distinctly more profitable, particularly relative to the rest of the retail sector, over the past two decades. Financial indicators

are only indirect measures of economic performance, however. Whether retailers exercise market power in reality is a matter for more detailed consideration of retail prices or, more appropriately, retail margins in specific markets.

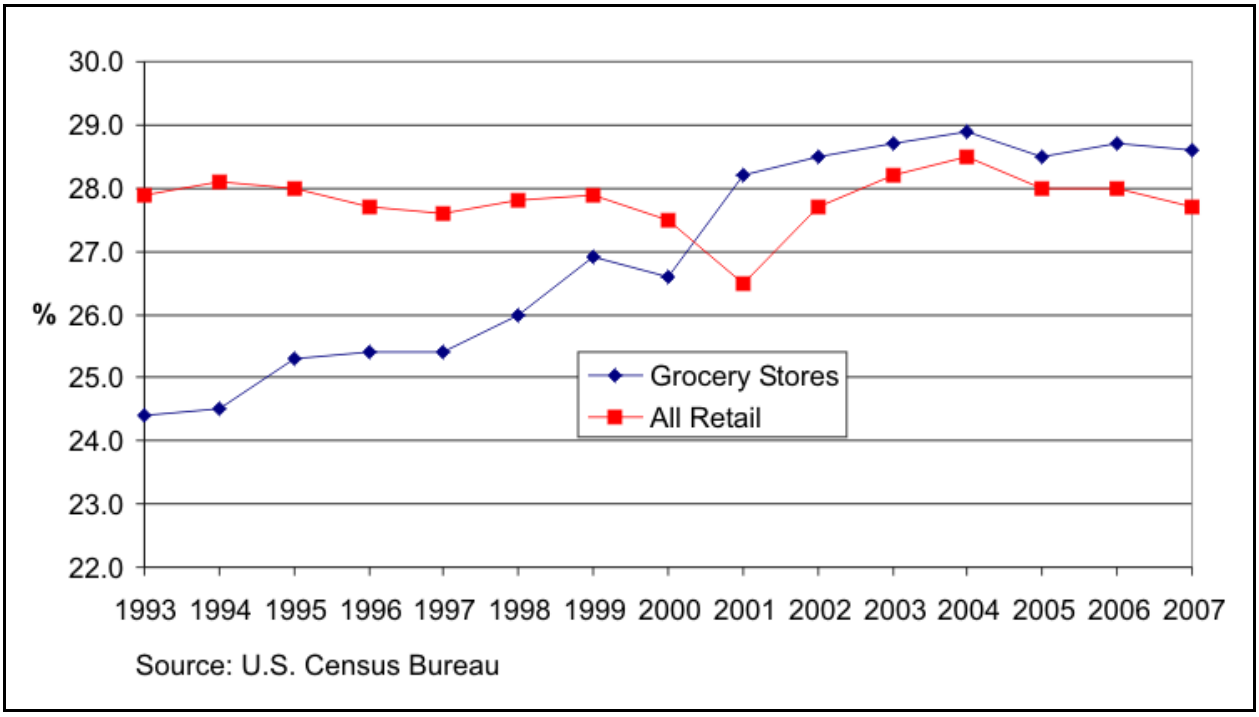

Figure 3. Retail Grocery Stores: Gross Margin as a Percentage of Sales

Concentration does not imply market power *per se.* Other features of food retailing may, in fact, be more important to retailer margins than simply concentration. First, retailers sell multiple products. Because shoppers incur significant fixed costs in searching for a particular store, retailers can indeed act as local monopolists once a store choice has been made. Because each store generally offers all the food products a consumer may need, and most potential substitutes, the store-choice decision typically does not change when prices of specific items change. Rather, consumers buy a substitute in the same store. This ability to internalize all of the pricing externalities that would be lost to competitors in any other shopping format, means that large retailers have an inherent source of pricing power.

Second, retailers have an incentive to be large regardless of the implications for pricing power. Spreading fixed costs of distribution, advertising and the like over thousands of products, retailers with huge selections are likely to be able to set lower prices than smaller, more focused retailers due to economies of scale and scope.

Third, retail markets are spatial, and local. Because much of the fixed cost of shopping involves driving to the store of choice, most consumers frequent the store that just happens to be the closest to home.

Fourth, retailers increasingly differentiate themselves by their private label offerings, in-store bakeries, or prepared and local foods. Fully 41% of shoppers described themselves as frequent buyers of private labels in 2007, whereas only 12% did in 1992 (Iposos, 2007). By competing in nonprice dimensions, retailers attempt to soften price competition, even in relatively fractured retail markets.

Fifth, there is considerable academic debate over whether scale economies are a significant factor in the rise of the "big box" food retailers such as Wal-Mart and Target. If scale economies are important, then a positive relationship between concentration and profit may, in fact, describe the structure of costs and not the exercise of market power.

Sixth, Devine and Marion (1979) use a unique experiment to show that price information, or the lack thereof, can be a source of market power as well. While supermarkets communicate prices often through food-page ads in local newspapers, and flyers through the daily mail, it is nonetheless impossible for consumers to know and compare the prices of all 30,000 stock-keeping-units (SKUs) in a typical supermarket. Without ready access to cheap price information, higher search costs raise the market power of stores that are able to attract customers through non-price methods.

Finally, if margins earned by retailers do indeed appear to be higher than they "should be," it may be due to market power in their role as buyers as much as in their role as sellers. In fact, much of the concern regarding retail concentration from farm-interests lies with the potential for oligopsony, or buyer, and not oligopoly, or seller, market power. Taken together, however, these attributes of food retailing mean that modeling pricing behavior in retail food markets is more complicated than in commodity markets. Nonetheless, arriving at a useful empirical conclusion on the question of retail market power requires that each of these potentially confounding factors be taken into account.

The Evidence

Despite the importance of retail supermarkets in the food distribution system, there is surprisingly little recent empirical research on market power exercised by retailers. In the 1980s, Lamm (1982) and Kaufman and Handy (1989) both find a positive relationship between concentration, or the potential for the exercise of market power, and prices. Cotterill (1986) uses a unique, store-level data set of prices charged for a typical grocery-basket of items for supermarkets in Vermont and finds that more concentrated markets have significantly higher prices than others, even when scale and organizational form are appropriately accounted for. Newmark (1990), on the other hand, argues that the existing set of retail concentration-price studies are flawed in that they use nonrandom retailer samples and, more importantly, do not allow for variation in income among store-markets. Correcting for these flaws, the relationship between concentration and price levels disappears. All of these studies are *ad hoc*, however, in that they do not attempt to explain the relationship between concentration and market power, only describe it.

More recently, structural models of wholesale and retail food pricing have attempted to fill this gap. A structural model attempts to explain a retailer's pricing decisions in a way that is consistent with market demand, and its strategic environment, both vertically with suppliers and horizontally with respect to competing retailers. Generally, this research has produced mixed results with respect to finding evidence of retail market power. Sudhir (2001) was the first to allow for both vertical—between retailers and suppliers—and horizontal—between suppliers—market power in the same model. He finds support for a model in which food manufacturers enjoy a first-mover advantage relative to retailers, but retailers use a simple, constant markup rule in which they do not compete against each other.

Using data from a single product category, many others either assume retailers do not compete against each other (Besanko, Gupta and Jain, 1998; Chintagunta, 2002) or provide empirical evidence that they don't (Slade, 1995; Sudhir, 2001). Each of these studies bases its conclusion on data for one or two relatively minor product categories, however, so it is not surprising that they find little interaction in prices. Richards and Hamilton (2006) find that retailers in a major U.S. market compete both in prices and variety, but tend to use variety—defined as the number of products offered in a category—as a strategic tool to soften price competition. Berto Villas Boas (2007) considers a number of different models of the vertical interaction between yogurt manufacturers and retailers in a single-market context. She finds that a model in which wholesale margins are set to zero and retailers set profit-maximizing prices provides the best fit to her yogurt data—implying that retailers enjoy both upstream and downstream market power. Still, these studies only indirectly address the issue of market power.

New Research

Following the food price spike of 2008, there has been a renewed interest in retail pricing behavior and the potential role of retail market power. As just one example, the authors of this article attempt to take each of the structural elements above into account in estimating a model of retail market power under the assumption that retailers play the role of platform managers, or intermediaries, in a two-sided market. Consumers have a preference for variety, and manufacturers demand retail distribution. Consequently, retail margins reflect the supply and demand for shelf space. Using retail scanner data from multiple retailers in a single, nonWal–Mart market, we found that retailers are slightly more competitive than what would be expected if they competed as rivals in a differentiated-products market. More importantly, retail market power increases in the number of products offered. In this regard, we provide an alternative explanation for the correlation between concentration and prices noted above. Our finding, however, suggests that supermarket retailers may not be perfect competitors, but we wouldn't expect them to be given the differentiated nature of the product they sell. The prices they charge are somewhat below what they would be were they to exploit the market power available to them.

Many industry commentators regard the movement toward private labels as an indicator of a sea-change in the shift of market power from manufacturers toward retailers. By marketing products that are nearly identical to national brands, retailers accomplish three things: they are able to build loyalty for their own store by offering a high-quality product at a lower price, they can price discriminate between consumers willing to pay more for their loyalty to a particular brand, and they are able to force national brand manufacturers to lower wholesale prices. In another recent study conducted by the authors using data from the same market as described

above, we show that this latter effect—shifting pricing power from manufacturers—is the most important. To the extent that private labels are, in a sense, wringing pricing power out of the whole system, this movement of pricing power downstream may be beneficial in terms of lowering consumer prices.

Market Power Implications of Supermarket Retailing Trends

Recent developments in food retailing suggest that supermarkets may face a more competitive landscape in the coming years, but critical questions remain. No discussion of market power in food retailing is complete without highlighting the role of Wal-Mart in enforcing competitive discipline on the entire market. A growing volume of empirical research confirms what most shoppers found out for themselves long ago—that retail food prices fall when a Wal-Mart opens nearby (Hausman and Leibtag, 2007). Until Wal-Mart's business model fails, prices will continue to be driven down due to their focus on supply chain efficiency, bulk buying power and their ubiquity in nearly every U.S. market.

At the same time, however, the growing strength of the organic / natural / local food sector represents somewhat of a challenge to the mass-market appeal of retailers like Wal–Mart, Target and Kroger. While each of these has developed their own strategy designed to take advantage of these trends, the big-box retailers are not seen as credible sources for local, healthy food. Witness the simultaneous growth in farmers markets, high-end supermarkets such as Whole Foods, and the movement toward community-supported agriculture. Finally, rising commodity prices may again bring the spotlight back to retailers' willingness to pass-through higher input prices to retail foods. To the extent that the average consumer does not appreciate the relatively minor role commodities play in the cost of processed foods (Leibtag, 2008),

retailers and manufacturers alike will be able to exploit this lack of transparency to create an opportunity for pricing power.

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