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Competition in Farm Product Markets: Do Long-Run Incentives Trump Short-Run Market Power?

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Abstract: This paper addresses buyer market power in farm product procurement markets. We argue that buyer power concerns are often overstated because traditional models of buyer market power are incapable of depicting the economic interactions that are fundamental to modern agricultural markets, where exchange is governed by stable contractual relationships among buyers and farmers. The exercise of short-run oligopsony power is inimical to the long-run interests of buyers in these settings because below-competitive returns will lead to the exodus of resources from producing the product. Policy proposals grounded in the presumed linkage between concentration, competition, and market power may well be misguided and detrimental to the objectives proponents seek to advance.

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Introduction

Market structure and competition in U.S. agricultural markets have long been important topics for researchers and policymakers, with the red-meat packing industry representing a key focus dating back as far as 1919 when the U.S. Federal Trade Commission investigated the so-called "big five" processing firms and issued a critical report, accusing the industry of manipulating markets, restricting throughput, harming producers and consumers, and eliminating competition (Myers, Sexton, and Tomek 2010). Focus shifted in the mid 20th Century to investigating the power of food manufacturers and sometimes retailers over food consumers using the structure-conduct-performance (SCP) methodology. Influential books by Connor et al. (1985) and Marion (1986) summarized much of this work.

However, soon after these books came into print, interest in the SCP paradigm began to wane. As documented by Bonanno and Brandolini (1990), economists found the SCP paradigm increasingly unsuitable for incorporating many of the new theories in economics examining firm interactions and strategies at the micro level, specifically theories about product differentiation, endogenous entry barriers, collusion, information asymmetries, and vertical interactions along the marketing chain. Agricultural economists began using structural empirical models based upon the framework of the new empirical industrial organization (NEIO) to obtain quantitative estimates of departures from competition in markets for farm product procurement and/or downstream sales. The advent of the NEIO thus saw the profession giving similar attention to market intermediaries' power as upstream buyers of raw farm commodities as to their power downstream as sellers of intermediate or final products.

With food budgets for the average U.S. consumer now comprising less than 10% of disposable income, and the market entry and rise to dominance of discount grocery retailers such as Walmart, the policy and research focus on food manufacturers' and retailers' potential oligopoly power over consumers has faded. It has been replaced by a persistent policy concern about food processors', handlers', and occasionally retailers' potential market power as buyers of farm commodities and the impact such power might have on the future of small farms and the viability of rural America. This concern has been manifest in provisions debated for inclusion in the 2002, 2008, and 2012 farm bills, stand-alone legislation—some of it currently active, regulations proposed under the Packers and Stockyards Act, and a well-publicized set of listening sessions conducted jointly in 2010 by the U.S. Departments of Agriculture and Justice on agricultural market competition and regulation.

The concerns about buyer power in agriculture have been triggered by increases over time in concentration within all sectors of the food-marketing chain, which have consolidated purchases in the hands of ever fewer buying firms, as well as a rapid escalation in the degree of vertical control exercised in farm product markets through various forms of contracts and upstream vertical integration. Although considerable research has documented the efficiency-enhancing effects of vertical coordination, the worry is that it may be used as a device to consolidate and extend buyers' market power, and that it usually works to the detriment of smaller farmers. Theoretical and empirical economic research has yielded ambiguous conclusions on these points and done little to quell concerns. Angst about buyer power and a disparate impact on smaller farms feeds ultimately into broader issues concerning declining vitality of rural America through loss of economic activity and depopulation.

The purpose of this paper is to address the issue of buyer market power in modern farm product procurement markets. Although our explicit focus is on the U.S., the evolutionary forces in agricultural markets that have precipitated the ongoing concerns are a worldwide phenomenon. We develop a point raised by Sexton (2013, in press) in an Agricultural and Applied Economics Association Presidential address that buyer power concerns may be overstated in many agricultural industries because traditional models of buyer market power are incapable of depicting the economic interactions that are fundamental to modern agricultural markets. Our hope is that this present piece will spur an important and timely discussion among those economists who study the structure of food and agricultural industries.

In what follows we first provide updated information on the evolution of concentration and vertical coordination in agricultural industries and argue that the available data are inherently limited in their ability to communicate a clear picture regarding procurement markets for farm products. We then discuss empirical evidence on competition and market power in farm product procurement, including descriptive evidence showing that a primary concern among farmers is the lack of competition among buyers to procure their production. We argue, however, that the logical inference made from such observations, namely that lack of competition is associated with buyer market power, may well be incorrect in modern markets where exchange is governed by stable contractual relationships among buyers and farmers. Further, policy proposals grounded in the presumed linkage between concentration, competition, and market power may well be misguided and detrimental to the objectives proponents seek to advance.

Such erroneous inferences could emerge from applying a standard short-run model of monopsony or oligopsony power to the prototype highly concentrated procurement market, a model that in our view is increasingly incapable of characterizing interactions between farmers

and downstream buyers in an ever-increasing number of markets. A standard short-run model of buyer market power is based upon buyers recognizing their power to influence price and, accordingly, reducing their volume of purchases relative to the competitive level to lessen the input price and increase profits. In such cases farm prices and profits are reduced below the competitive level that is necessary to sustain resources in the industry, thus leading to exit and reduced productive capacity. This outcome, we argue, is inimical to the long-run interests of buyers of the farm product. Whereas this effect would largely be an externality in a prototype oligopsony model, it is internalized by buyers in a modern agricultural market characterized by contract production and long-term relationships between buyers and sellers. In short, buyers with long-run horizons are motivated by simple self interest not to exercise their short-run buyer power due to the long-run adverse consequences.

Structure of Markets for Procurement of Farm Products

Procurement markets for raw agricultural products have important structural attributes that distinguish them from many non-agricultural manufacturing industries. Rogers and Sexton (RS, 1994) delineated four characteristics that in their view were key to defining agricultural-product procurement markets relative to prototype input markets. Table 1 reproduces this list. RS argued that these characteristics alone or in combination can lead to "compelling structural evidence of buyer market power" (1994, p. 1144). They called into question the conventional wisdom of the time that "monopsony power can be analyzed readily using the tools of monopoly power analysis" (1994, p. 1144), and urged the profession to pay closer attention to the issues of buyer power as opposed to seller power because of important distinctions in the two sides of the market.

RS point 1 was that farm products are often bulky and perishable with relatively high shipping costs and hence relevant procurement markets that are narrower in geographic scope

than markets for the finished products. Likewise, point 2 argues that farm inputs are narrower in product-characteristic scope than the finished products they produce and processors have very specific input needs that permit few if any substitutes. RS remind the profession, point 3, that farmers have specialized assets that create a barrier to exit, making farm supply inelastic (and, hence, vulnerable potentially to exploitation through buyer power) and, point 4, institutions of seller power such as cooperatives often exist in input markets and might counterbalance buyer power.

We have no quarrel with these four points, but argue that RS failed to consider essential characteristics of the buyers of agricultural products in arriving at their conclusions. In particular, processors of agricultural inputs also have enormous sunk costs in both equipment but also in their developed product lines and brands that make them as reliant upon the producers for consistent product quality and volume as the producers are to them to provide a market outlet. Just as geography may inhibit immobile agricultural products from traveling in search of better selling opportunities, so, too, do they restrict a geographically immobile processing facility's ability to procure raw product from long distances. Thus, whereas a single buyer facing many sellers may have the ability to extract monopsony rents in the short run, its long-run interests in preserving supplies of an essential input may well trump the short-run profit maximization objective emphasized in traditional market power models.

Second, just as farmers have very inelastic supply curves in the short run, we argue that buyers' input demand functions for farm products are highly inelastic due to any of several factors that are likely to characterize in some combinations most modern agricultural markets. They include fixed capacity of processing facilities, fixed downstream selling contracts for finished products, and fixed access to retail shelf space. These structural attributes of modern

agricultural markets are seldom considered but in our view are key forces determining buyers' procurement practices and the extent to which they "compete" for farmers' production.

Industry Trends: Concentration

A key factor motivating angst among farmers has been the secular trend toward increasing concentration among agricultural market intermediaries and the attendant implications for farmers' selling opportunities. RS examined concentration statistics from the 1987 Census of Manufactures for fifty-three food and tobacco industries identified by the Standard Industrial Classification (SIC) code. As SIC codes expand from four-digit to six- and seven-digit formulations (increasingly fine tuning industry definitions), the national concentration of the largest firms representing the greatest share of sales value increases. RS selected from these categories and showed how the five- and seven-digit classifications had an average four-firm concentration ratio (CR4) of 61.3 "with twenty-four of the thirty-eight national product markets having CR4 > 50, a commonly used benchmark at the time for separating markets into workable competition and noncompetitive groups" (1994, p. 1144).

The Census of Manufactures abandoned the SIC classification, replacing it with the North American Industrial Classification System (NAICS) in 1997. In the new quinquennial reports, the finest reported delineation of an industry is the six-digit NAICS code. The six-digit NAICS codes covering the food manufacturing industry are presented in table 2, which shows the 2007 values (the latest year available) for the key industry variables of number of firms, total value of shipments, four-firm concentration ratio (CR4), as well as the Herfindahl-Hirschman index (HHI), which RS did not report. Relative to CR4, HHI is usually considered a better measure of concentration because it weights the concentration by firm shares of sales in a manner that gives more weight to larger firms than does the CR4.[1] The Federal Trade

Commission (FTC) uses the HHI as part of its mergers and acquisitions guidelines. Table 2 also shows the percentage changes in each of these values since the 1997 Census, thus providing a reference for how industry structures have changed in the last decade.

The bottom of table 2 includes some simple statistics to compare with those of RS, with the caveat that we are comparing the NAICS to the SIC. Whereas RS (1994, p. 1144) note that by 1987, "most industries have experienced decreasing firm numbers and increasing seller concentration over time," the decade from 1997 to 2007 shows stabilization in food manufacturing with an average firm exit of just one percent at the six-digit NAICS level. While half of all industries have seen at least four firms leave, with some industries having faced extremely large numbers of firm closures (for example, 53% of sugarcane mills have shuttered), there have been roughly just as many new firms opening over the decade (for example, there were 58% more soybean processors in 2007 than a decade ago).

Overall, the average CR4 and HHI in 2007 for the food manufacturing industries were 50.3 and 1,048, respectively. Under the FTC guidelines, horizontal mergers of firms would likely be approved for industries with HHI below 1,000. Among 47 NAICS industries in table 2, 25 meet this criterion.[2] Mergers receive a great deal more scrutiny when the HHI is above 1,800. Nine NAICS industries in this table have concentrations above this threshold. The largest is NAICS industry 311422, specialty canning, where HHI = 2,885.[3] The greatest increase in concentration from 1997-2007 came in fluid milk (311511) and seafood canning (311711), industries where the HHI increased by 426 and 266 percent, respectively. The largest decreases in concentration were in the chocolate confectionary (311320) and flour mixes and dough (311822) manufacturing sectors, where the HHI fell by 50 and 47 percent, respectively.

Interestingly, two of the NAICS industry codes receiving the greatest scrutiny for market power, non-poultry animal slaughtering (311611) and poultry slaughtering (311615), have CR4s of 59.4 and 45.7, respectively, and the HHI has actually dropped by 2 percent since 1997 in non-poultry animal slaughtering. These statistics, however, mask important differences in considering market power in the selling as opposed to the buying side of the market and illustrate the perils of relying on national indices to make inferences about concentration and market power. First, sales (which the concentration figures examine) concern markets that are national and often international in scope. Procurement markets for agricultural products, on the other hand, are often of more limited geography, as RS (1994) noted. While the FTC might consider an HHI in non-poultry animal slaughtering of 1,047 to be at its threshold for merger approval if the FTC equated this NAICS code to a relevant product market, what we do not see in table 2 is the relevant concentration in the procurement markets for the agricultural product input. Further, both beef and pork processing are subsumed in the same NAICS industry. All meats are arguably competing products in the minds of consumers, but hogs are not a substitute for cattle in the processing stage. In other words, what statistics in the Census of Manufactures cannot report is the relevant concentration in the purchasing of inputs, which is the real concern of farm producers and, increasingly, of policy makers.

The U.S. Department of Agriculture, Grain Inspection, Packers and Stockyards Administration (GIPSA) reports finer details on CR4 (but not the HHI) for the livestock industries, allowing a somewhat clearer picture of procurement markets to emerge. Table 3 shows the national CR4 for industries involved in the processing of steers and heifers, sheep and lambs, hogs, broilers, and turkeys from 1980 to 2010—classifications that represent at least relevant product markets for procurement, if not relevant geographic markets. From 1980 to

2010, four-firm concentration in these meat packing industries has increased an average of 69 percent, with the largest increases occurring in steer and heifer packing (an increase of 136 percent from a CR4 in 1980 of 36 to a CR4 of 85 in 2010) and hog packing (an increase of 91 percent from a CR4 of 34 in 1980 to a CR4 of 65 in 2010).

Most of this increase in concentration occurred in the 1980s. The fifteen years from 1980 to 1995 saw the biggest changes in concentration occurring in steer and heifer processing with a 125 percent increase in CR4. The next highest increase is in broiler processing, with a 44 percent rise in CR4 from 32 to 46. Over the next fifteen years, however, steer and heifer concentration remained virtually unchanged, with the CR4 increasing only 5 percent from 81 to 85 between 1995 and 2010. Concentration in hog processing still went up by 41 percent, while the CR4 in sheep and lamb processing actually declined 10 percent over this time period. Broiler and turkey processing concentration has increased over the time period, but at a much lower rate than hogs. Without a time series of statistics on HHI for the relevant procurement markets, it is hard to tell, but quite plausible, that most of the slowdown in mergers, and, hence, the recent stability in concentration in these industries is simply due to them bumping against thresholds that trigger federal merger scrutiny.[4]

Many food manufacturers operate multiple processing facilities, and a much less discussed point is the role of individual plants in fostering competition in procurement markets and the fact that number of plants has been declining along with increases in concentration due to mergers and acquisitions. In a study of the Texas Panhandle cattle-feeding region, Crespi and Sexton (2005) found that the number of plants had a greater impact on pricing than the number of firms.

Given the regional nature of livestock purchases, plant-closing decisions by large multi-plant firms can greatly influence the nature of competition in these markets. Table 4 shows that over the same time period that concentration has increased, the number of slaughter facilities for cattle, hogs, and lamb and sheep has declined dramatically. Although increasing concentration seems to have leveled in recent years, as shown in table 3, not so the number of plant closings. From 1980 to 2010, an average of 75 percent of the U.S. slaughter facilities for beef, pork and lamb that report to the Packers and Stockyards Program closed. Most of these closures (around 55 percent) occurred from 1980 to 1995 but an average of 21 percent closed between 1995 and 2010. Comparing tables 3 and 4, for example, in the case of cattle, we see that, whereas CR4 increased only 5 percent from 1995 to 2010, cattle slaughter facilities declined by 29 percent or 144 fewer facilities. As one cattle producer summarized,

> While potentially there are four market participants, what we see typically region by region is that there are really one to two meaningful participants, rarely three, and four meaningful participants is very much of an oddity. -- Bruce Cobb, General Manager, Consolidated Beef Producers, Canyon Texas.

The argument that the facilities that remain following plant closures are larger and can absorb the capacity from shuttered plants neglects the regional impacts and the ever-increasing importance of shipping costs in defining regional procurement markets. From 1995 to 2010, as plants closed, the prices of all goods (as measured by the CPI) increased by 36 percent or roughly two percent per year, but the price of gasoline increased by 145 percent (nine percent per year) and number 2 diesel increased by 170 percent (11 percent per year). Even if in principle a feedlot could send cattle an extra 500 miles to a processor offering a better price than the feedlot's nearby buyer, the cost of doing so (both in terms of shipping costs per se, as well as the loss in product value that occurs typically in transit) creates feedlot dependency on the local

buyer. So, too, however, is there a similar dependency on the buyer's part to feedlots proximate to its processing facility.

Industry Trends: Vertical Coordination and Contracts

Today's consumers demand a wide variety of food choices, safe food, and nutritious food. And the share of average income now devoted to food has reached a point where so many can afford to be even more demanding in terms of the attributes of the foods they consume. To meet the diverse demands of billions of consumers, the marketing chain, while becoming more global, has necessarily become more coordinated.

The ever-greater vertical coordination between producers and highly concentrated market intermediaries is reflected through increased use of contract exchange mechanisms and decreasing use of cash markets. These trends are a great concern to many producers and their advocates in Congress and state legislatures. Contracts governed at least 39 percent of the value of U.S. agricultural production in 2008, up from 28 percent in 1991 and nearly four times the 11 percent recorded in 1969 (MacDonald and Korb 2011).

The rate of increase in vertical coordination through contracts has been most pronounced in the U.S. in the livestock sector, where the share of cattle marketed under vertical coordination mechanisms doubled between 1980 and 1998 from about 10 percent to more than 20 percent. The pace of vertical coordination has accelerated rapidly since then, with negotiated cash procurement accounting for only 34.1 percent of cattle transactions in 2009-10 (Ward 2010), with additional declines occurring since then. Even in the early 1990s nearly 90 percent of hogs were purchased in the spot market, but by 2010, the percent of spot market hogs had fallen to the 5-7 percent range, with 68 percent acquired through production contracts (Lawrence 2010, O'Donoghue et al. 2011), and a fourth acquired via integrated facilities owned by processors.

Combining marketing and production contracts, based on the value of the commodity, some 60.2 percent of the contract agriculture is in livestock based on 2008 data, with crops accounting for the remaining 39.8 percent. Corn, with 10.8 percent of value is the most important contracted crop (MacDonald and Korb 2011).

Lack of Competition in Farm Product Procurement and Traditional Buyer Market Power

Farmers, legislators, regulators, and economists alike have voiced concerns about lack of competition in farm-product procurement, most notably in the livestock sector (MacDonald and McBride 2009). Farmers' concerns about lack of buyers for their products was a key theme in the Workshops on Agriculture and Antitrust Enforcement, as illustrated in the summary provided by the DOJ:

> A consistent complaint was that, at various stages of the food chain, there are only a handful (if that many) of buyers or sellers, resulting in a lack of options for producers and lower prices for their commodities or higher prices for supplies. Producers often contrasted today's concentrated markets with atomized markets of the past years, recalling times when they had plentiful trading partners (DOJ 2012, pp. 5-6).

U.S. Secretary of Agriculture Vilsack described the lack of selling opportunities for farmers this way: "Over the years, as I have traveled around the country, I have heard that there is an increasing concern that there are, essentially, fewer buyers to do business with and that some are saying that producers or feeders have a hard time getting bids or contracts for their livestock" (Livestock Industry Workshop 2010, 63: 16-21). The paucity of competition among buyers was said to create situations "…where feedyards are getting one bid, one bidder. They only get one person who calls on them from one company. They sell their cattle to one place, whether they're in the cash market or not, and that's because they have one opportunity" (Livestock Industry Workshop 2010, 224: 16-24).

Responding to these sentiments and to a mandate contained in the 2008 Farm Bill, GIPSA proposed regulations in 2010 that would have significantly altered the way livestock and poultry processors conducted business. The goal of the USDA in promulgating these regulations in the words of Edward M. Avalos, Undersecretary for Marketing and Regulatory Programs, was to

> . . . improve fairness and transparency in marketing of livestock and poultry . . . What is driving the need to use [GIPSA's] authority under the Packers and Stockyards Act is our concern about the loss of farmers and the depopulation of rural America (p. 27).

The proposed regulations drew thousands of comments from producers, processors, and others. Many farmers expressed concerns over the small number of buyers for their livestock. Many farmers and farmer advocates supported the proposed regulations but others argued that the proposed restrictions on contracting would exacerbate matters in essence by causing processors to achieve needed vertical coordination through integration. For example, a Michigan pork producer asserted that the proposed rule would "…force more concentration and consolidation in the pork industry. It will drive packers to produce more of their own hogs, reducing their need for hogs from producers like me" (Taylor 2010).

Contract growers in the poultry industry also communicated the lack of buyers in their industry when recounting that, after being terminated by one integrator, they were unable to switch to another (Poultry Industry Workshop 2010, 137: 3-11). Growers believe that "[t]he lack of competition in a given geographic region has led to integrators with all the power, this leaves the grower with little to no choice" (Poultry Industry Workshop 2010, 167: 3-10).

Although the dairy industry in the U.S. is characterized by a regulated pricing structure and farmer cooperatives marketing the majority of the milk produced in the nation, dairy producers echoed concerns over the paucity of buyers in the Dairy Industry Workshop. Assistant Attorney General Christine Varney summarized them: "we know that dairy farmers are

concerned about a lack of choices for buyers and about the way that their milk is priced…" (Dairy Industry Workshop 2010, 15: 17-20).[5]

Yet, despite the consistent refrain among farmers regarding the paucity of buyers in their geographic region and the extent to which the available buyers actually engage in direct competition, the NEIO literature on buyer power has not found the presence of significant oligopsony power. Early empirical estimates suggested that, after technology-induced consolidation had occurred, distortions in prices paid by processors for cattle were only about one percent of the cattle price and had been decreasing as beef processing became more concentrated (Schroeter 1988). Subsequent studies found distortions in the range of one to three percent in the cattle price paid by processors (Azzam and Schroeter 1991; Koontz, Garcia, and Hudson 1993; Azzam and Park 1993; Weliwita and Azzam 1996; Muth and Wolgenant 1999), suggesting that market power in beef packing had not increased appreciably over the intervening years. A more recent estimate of the suppression of cattle prices due to oligopsony power was, however, somewhat higher—in the range of 5 to 10 percent (Crespi and Sexton 2005).[6]

The empirical literature on oligopsony power in the market for hogs is sparse relative to that for cattle and beef and is focused primarily on estimating farm-to-wholesale (FW) marketing margins, instead of market power parameters, and making inferences about competition based upon the behavior of margins. If, as concentration increased over time, packers were exercising increasing oligopsony power by reducing the price they paid for hogs, the FW margin would increase over time after controlling for other factors. However, this is not what has been observed. From 1970 to 1998, the real pork FW margin declined by 65% (USDA 2000). Brester and Marsh (2001) found that technological changes in meatpacking contributed to proportionately greater reductions in marketing margins and increases in real hog prices over

time—a one percent increase in meatpacker productivity was estimated to reduce the pork FW margin by 1.43 percent.

This brief summary of empirical studies of buyer market power in U.S. agriculture is illustrative of the findings in the broader literature.[7] The U.S. Government Accountability Office (GAO) recently conducted a thorough study on the issue and summarized the literature as follows:

> The empirical economic literature has not established that concentration in the processing segment of the beef, pork, or dairy sectors or the retail sector overall has adversely affected commodity or food prices. We reviewed 33 studies published since 1990 that were relevant to assessing the effect of concentration on commodity and food prices in these sectors. Most of the studies that we reviewed either found no evidence of market power or found efficiency effects that were larger than the market power effects of concentration (GAO 2009, p. 3).

What the empirical literature in meatpacking does strongly support, however, is the proposition that economies of size and consistent operation of plants at efficient capacity are essential forces driving processors' procurement policies.[8] Because these scale-related efficiency gains are based upon achieving consistent and optimal levels of throughput, packers must insure a steady supply of live animals to their plants. The efficient way to achieve this goal is likely to involve substantial vertical coordination, known in the industry as "captive supplies," so that attainment of sufficient throughput essential to a plant's profitable operation (and with the characteristics desired by the processor) is not left to the vagaries of spot-market competition. The GAO in its 2009 study also recognized the essential role of economies of size and stable flow of raw product, as did the comprehensive study of competition in the livestock sector coordinated by the Research Triangle Institute in response to a mandate to GIPSA contained in the 2002 Farm Bill:

> Large processing plants achieved cost economies by ensuring a smooth and undisrupted flow of hogs so they could operate their plants at near full capacity. Therefore, their desire to continue purchasing hogs to achieve these cost savings could overwhelm any incentives to exercise market power by restricting purchases (GAO 2009).
>
> When both are operating close to capacity, smaller plants are at an absolute cost disadvantage compared to larger plants. When larger plants operate with smaller volumes, they have higher costs than smaller plants operating close to capacity and, thus, have incentive to increase throughput. For all plants, large and small, average total cost increases sharply as volumes are reduced (Muth et al. 2005, p. ES-6).

A Unifying Framework

Thus, the structural evolution of most agricultural markets reflects increasing concentration among processing and marketing firms; processing and packing plants that are highly capital intensive, geographically dispersed, and declining in numbers; and an increasingly vertically coordinated market chain, with contracts and (in some sectors) upstream vertical integration by processors replacing spot-market exchanges. Producer complaints about lack of selling opportunities are legion. Yet, empirical evidence of buyer market power in the traditional sense of firms restricting purchases to decrease the input price is scant. On the other hand empirical evidence strongly supports the importance of economies of scale and a stable supply of farm product with desired characteristics to the efficient operation of processing facilities and the successful marketing of finished products to downstream buyers.[9]

This evidence is readily reconciled if one steps back from the traditional short-run market power formulation and considers a long-run optimization framework (Sexton 2013, in press). An inevitable consequence of the exercise of traditional short-run buyer oligopsony power for a commodity is that prices received by farmers are depressed below the competitive level. Consistent suppression of farm prices in this manner will cause long-run returns to investment in

production of the commodity to fall below the so-called "normal" or competitive level, causing resources to exit the industry. If downstream buyers have extensive investments in assets that are committed to the specific industry (in the sense that they cannot be used for other products) and geographic location (in the sense that they cannot be moved), it is very likely not in the long-run interests of buyers for resources to exit production of the farm commodity in this setting because their exit will jeopardize returns on the buyers' own investments which rely upon a secure and stable supply of farm product.

Rather, it would seem that the optimal strategy in these settings is to secure a stable supply of farm product input that is (a) produced efficiently (i.e., in a least-cost manner, given quality characteristics of the product), and (b) transacted efficiently. Contracts and upstream vertical integration come to the forefront as vertical exchange mechanisms conducive to locking in stable supplies and minimizing transactions costs.[10] Spot or cash markets are likely to be regarded by both buyers and most sellers as an inferior alternative. Buyers will regard contracts as an inferior alternative to vertical integration the greater are the restrictions and limitations imposed on contracts through policies such as the proposed GIPSA regulations.

Following Sexton (2013, in press), we define the per-unit market surplus to a transaction between buyer *i* and seller *j* as $S_{ij} = V_{ij} - c_i - c_j - T_{ij}$, where V_{ij} is the price of the finished product paid by consumers or intermediaries further downstream, c_i and c_j are per-unit variable costs of buyers and sellers respectively, and T_{ij} is the transaction cost of exchange between *i* and *j* expressed on a per-unit basis. V_{ij} is a function of the characteristics of the farm product produced by *j*. S_{ij} thus defines the size of the pie that will be divided between *i* and *j* if they execute an exchange. A farmer's payment, P_{ij} from transacting with buyer *i* can be expressed in terms of the

minimum amount required to call forth production, c_j, plus a share, $0 \leq \alpha \leq 1$, of the market surplus:

(1) $P_{ij} = c_j + \alpha S_{ij}$.

Buyers in any market period require a fixed amount of farm product input for any of the reasons mentioned earlier. We make no attempt here to specify a fully dynamic model that might enable an optimal procurement strategy to be derived analytically. Rather, we define what we consider to be the likely characteristics of exchange between farmers and downstream buyers in this setting:

- Buyers will seek exchange mechanisms that elicit farm products with the characteristics they desire and that limit transactions costs. These goals are likely to be achieved best through contracts or vertical integration.
- Buyers will seek to conduct exchange with the most efficient producers as a way to increase S_{ij}.
- Buyers will seek to satisfy their production needs by engaging relatively few suppliers so as to minimize transactions costs.
- Among the group of suppliers a buyer engages, the buyer has incentive to offer a price that insures the long-run viability of those farming operations. This will be consistent with the buyer's long-run optimization because it fosters a symbiotic relationship between the buyer and farms supplying it, thereby helping to insure the presence of a stable supply of farm product and limiting transactions costs of procuring the farm product.

This symbiotic relationship between buyer and seller can emerge only in settings when the buyer can internalize a sufficient amount of the benefit from fostering a stable supply of the farm product over the long run. Increasing concentration among buyers is critical to achieving this outcome.[11] Thus, it is fully consistent with the market framework set forth here for the exercise of buyer power to be inversely related to the market's buyer concentration and degree of vertical coordination.

The persistence over time of a mutually beneficial relationship between producers and a buyer depends upon the buyer maintaining a long-run optimization horizon. In other words if the buyer encounters a situation when the future is discounted heavily, e.g., due to severe financial stress, then the buyer's optimum can revert to the short-run optimum and exercise of any market power at the buyer's disposal.[12] An extreme manifestation of such buyer power is what is known as the "holdup problem." (Goldberg 1976). A producer who commits to acquiring assets specific to a particular buyer (as is the typical case with broiler contracts, among others) is vulnerable in any period to a contract renegotiation on less favorable terms than the original agreement. The long-run costs to buyers who exploit such short-run power, however, rules out its use in all but extreme circumstances of buyer financial distress.

Some policy makers are apt to view aspects of this type of market equilibrium as undesirable. In particular, it is very difficult for small producers to compete for contracts in this environment. In a scale intensive agriculture, small producers are likely to be less cost efficient than their larger rivals, therefore requiring a higher P_{ij} to remain viable in the long run. Transaction costs of dealing with many small farmers will be higher than the associated costs of dealing with a few large farmers, and small farmers may also be less effective than larger counterparts in producing the quality characteristics needed to maximize V_{ij}. Thus, the concerns

expressed by Undersecretary Avalos in justifying the USDA's support for the GIPSA regulations would be unresolved in these settings.

The emerging trends among some consumes to demand additional credence-type attributes in their foods, such as locally produced, sustainably produced, humanely produced, and fairly traded products, may in the short-run provide a sanctuary for small-scale producers who can target these niches in an effective manner. The problem is that, as these niches grow, the additional volumes transacted create opportunities for larger operations to exploit the scale economies that seem inevitable regardless of the product or its specific attributes. The need for vertical coordination to insure consistent supply of these emerging product attributes is also apparent. Thus, the opportunities for small-scale producers can give way quickly in these settings, as appears increasingly to be true for organic production, as illustrated in the words of Colorado organic rancher Armando Valdez:

> My experience working with some of these retailers, especially the organic natural markets, if you're a smaller rancher or producer, it's much more difficult. Unless you come with 200 head, they don't even want to talk to you…. We tried to market to Whole Foods in the past, and they told us we just don't have the numbers. And I don't consider myself a small, small producer. We have 300 head of cattle. And they still wanted more (Livestock Industry Workshop 2010, 174: 4-15).

What Does Market Power Mean in Coordinated Markets and How Do We Measure It?

In the NEIO framework buyer market power is measured by a parameter, often designated as θ, that ranges on a scale from zero (perfect competition) to one (pure monopsony) based upon observation of the extent to which the farm price is depressed below the value of its marginal product, i.e., below the value of buyers' input demand function. Production of the farm product, thus, is also depressed below the competitive level. Under the theory of behavior in coordinated

markets that has been sketched here market power measured according to the NEIO framework will be near zero, as, of course, has most often been the case.

An alternative measure of "market power" presents itself within the vertically coordinated market framework based upon the division of the market surplus between farmers and downstream buyers. This is measured by the value of α in equation (1), where like the NEIO θ, α ranges on the unit interval. Important to define is the particular value of α, say α^*, such that the farming operation earns at least the normal return on investment that is sufficient to sustain the resources in production in the long run. In principle, α^* could be given a *j* subscript because its value will differ among heterogeneous farmers. However, putting aside this complication, the theory sketched here is that in settings when the coordinated, symbiotic procurement markets are able to emerge the minimum value of α that will be observed is α^*.

Indeed, observed deviations from α^* would be rare within the fully vertically coordinated market chain described here. We have already described instances when $\alpha < \alpha^*$ and even α converging upon zero could be observed. The converse case of $\alpha > \alpha^*$ would emerge in the face of severe demand or supply shocks that were sufficient to disrupt the vertically coordinated equilibrium. For example, a severe negative shock in supply could cause buyers who would not ordinarily solicit purchases outside of a designated group of suppliers to compete aggressively to secure the patronage of geographically distant producers who are supplying other buyers. A significant positive demand shock could precipitate similar behavior.

Empirical estimation of the NEIO θ faces some daunting econometric challenges (Perloff, Golan, Karp 2007), but on the data side the requirements are to have sufficient data be able to estimate the demand for the farm product input and the farm supply function. Because the demand for the farm product will not be directly observed in the price and quantity data if buyers

exercise oligopsony power, some knowledge of or ability to estimate buyers' variable costs and thereby to derive farm demand from a downstream demand that is estimable will also typically be needed. Estimating α would require data on farm prices, prices received downstream by buyers, farmers' and buyers' variable costs, and transactions costs. Recognizing the close link between farm variable costs and farm supply curves, the data required to estimate θ and α are, thus, very similar, with the omission of transactions costs from the NEIO model because it is fundamentally a spot-market model wherein the role of transactions costs is typically ignored.

Evaluation of Policies to Regulate Vertical Coordination in Agricultural Markets

Various legislation currently before the U.S. Congress and being considered for inclusion in the 2012 Farm Bill is intended to limit buyers' ability to use specific means of vertical coordination and to push them in the direction of utilizing spot markets for farm-product acquisition. Evaluated in the light of the analysis presented in this paper, these policies could, if enacted, work quite opposite of what proponents intend and be detrimental to farmer welfare.

Such efforts are problematic in multiple dimensions. First and most widely understood among economists is that foreclosing vertical coordination options will be detrimental to the efficient operation of markets, reducing the overall surplus generated in them.[13] Under a standard perfect competition or short-run market power model, such an effect would, ceteris paribus, raise costs, reduce volumes traded, raise final product prices to consumers, and reduce prices paid to farmers for the raw product input. Even if they conceded the efficiency gains associated with vertical coordination, proponents interested primarily in the distribution of returns to farmers could well claim the policies would benefit farmers on net if they reduced processors' market power in procurement by compelling greater activity and, hence, greater competition in the cash

market. Although the overall pie may have shrunk, farmers would receive a larger share of it. Similarly smaller farmers might face a more level playing field if transactions were concentrated in the cash market.

Our analysis suggests, however, that such logic is flawed. Although contracts are certainly not without coordination problems themselves (Wu and Roe 2007, Wu 2010), in a cash market with arm's-length transactions no long-run symbiotic relationship between buyers and sellers can be fostered. The optimal strategy for buyers in these settings is to exercise whatever short-run market power they possess, and, given the structural oligopsony character of the typical farm product procurement market, the impacts of that market power, particularly for the distribution of market returns, can be significant. Indeed this is a fundamental point that emerges from a series of papers that apply a short-run oligopoly-oligopsony model to agricultural markets—although the market efficiency (deadweight loss) impact of moderate oligopsony power is small, the distributional impact is much greater, enabling intermediaries to capture much larger shares of the surplus generated in a market than they would under perfect competition.[14] Thus, the irony is that, relative to vertical coordination, spot transactions are more likely to expose sellers to buyer oligopsony power, the very outcome proponents seek to avoid.

Interest in how packers acquire livestock and attempts to limit packer ownership are longstanding (Saitone and Sexton 2012). Policymakers have been promoting legislation to influence farm product procurement markets in livestock in three key dimensions: limitations on packer ownership of live animals, requiring minimum spot market purchases, and regulating contractual provisions. Despite the clear efficiency incentives for vertical coordination, including packer ownership, in livestock procurement, proponents of prohibiting packer ownership claim that such a policy would increase packer procurement via spot market transactions. This

argument seems clearly to be flawed because the next best alternative to the vertical coordination sought through ownership would not be spot markets but, rather, procurement through contracts. Recognizing this fact, legislation has also been proposed to mandate a minimum level of packer purchases via spot market transactions (e.g., HR 5247 and S. 460). Although regulation of packer procurement methods is not at this time part of the 2012 Farm Bill, legislation surrounding packer ownership is still being debated.

While many versions of such legislation have been promulgated, the most recent version brought before the Senate in February 2012 (S. 2141) seeks to amend the Packers and Stockyards Act to make it unlawful for a packer to own, feed, or control livestock intended for slaughter more than 7 days prior to slaughter.[15] In addition, Senators Grassley (R Iowa) and Conrad (D North Dakota) have introduced an amendment to include the content of S. 2141 as part of the 2012 Farm Bill during the Senate's Farm Bill debate.

As contract exchange has assumed increasing importance in U.S. agriculture, increasing attention has been given to proposals to regulate contract provisions.[16] The 2008 Farm Bill mandated the Secretary of Agriculture to promulgate regulations to establish criteria for what constitutes "undue or unreasonable preference or advantage" under the Packers and Stockyards Act.[17] In June 2010, GIPSA responded with a broad and aggressive regulatory proposal that, as noted, was subject to extensive debate and commentary. Although Congress effectively stripped the majority of content from the proposed regulations by not providing funding, the debate over regulation of contractual provisions continues. [18]

Among the most contentious provisions in the proposed GIPSA regulations were those specifying permissible contract terms. The proposed regulations prohibited packers from applying a premium or discount to the purchase price of livestock without offering a

revenue/cost justification associated with the adjustment (GIPSA 2010, §201.210(a)5). In addition, they specified that processors must maintain records of justifications for differential prices paid and augmentations made to standard contracts offered to producers (GIPSA 2010, §201.94b).

Although these proposed regulations were not enacted due to Congress's intervention, recent attempts to influence the contracting structure in the livestock industry have been made through stand-alone legislation. Identical bills introduced in the House of Representatives (H.R. 2631) and in the Senate (S. 1026) would amend the Packers and Stockyards Act to prohibit "anticompetitive" forward contracts. Such contracts are defined as those that lack a firm base price, are not offered for open public bid, determine price based upon a formula, or provide for the sale of more than 40 cattle or 30 swine.

In essence, these various provisions to restrict contracts attempt to create a spot market for contracts. By requiring uniformity in the provisions, limiting the number of animals that can be transacted, and requiring an open bidding process proponents hope to create a level playing field for small producers and to incite aggressive bidding among buyers and sellers for contracts, i.e., a spot market.

The flaws in this logic are by now probably sufficiently apparent that little more need be said. A spot market, whether it is for the direct exchange of cattle or for a contract to exchange cattle, incentivizes buyers to exercise any short-run oligopsony power they can because the detrimental impact on future supplies of such market power is largely an externality (see footnote 11). Uniformity and public bidding for contracts would specifically prevent the long-run symbiotic relationships between buyers and sellers from emerging, and these are the

relationships that we argue give farmers the best opportunity in modern agricultural markets to earn at least a competitive return on their investments.

Such regulations would also increase the transactions costs of exchange relative to the status quo, and some portion of those higher costs would surely be transferred to producers through lower prices. Indeed, the growing demand for locally produced, identity preserved, organic and other recently popular production systems that now need large and consistent supplies would be harmed by legislation forcing buyers to eschew contracts that more readily control the attributes that flow "from farm to fork," as such advocates of these products desire. Finally, as Saitone and Sexton (2012) note, regulations that prohibit or discourage (through incentivizing lawsuits) the use of premiums and discounts in contracts discourage the production of differentiated and high-quality products that are essential to producers' and marketers' success in modern agricultural markets.

In contrast to the policies being contemplated now that deter beneficial long-run relationships from emerging, beneficial policies can facilitate their emergence. For example, many producers are suspicious of contractual arrangements that specify premiums and discounts that are ultimately subject to determination by the processor. Third-party inspections and certification, whether by government or industry marketing orders, could allay such concerns.

Conclusion

Although this discussion has focused on the U.S. and the livestock sector in particular, the trends described herein and the increasing need for vertical coordination between producers and market intermediaries are rather ubiquitous across the developed and developing world and across most agricultural industries. The developments have happened first and faster in livestock than

elsewhere and, thus, livestock has been the focal point for both research and policy proposals pertaining to concentration and vertical coordination.

The developments discussed herein have been precipitated both by technological advancements in farm production and processing and by key trends in consumer demands for food. We see neither of these factors abating but, rather, the likelihood is that they proceed apace or accelerate. Certainly the advancement of technology seems inexorable, and it occurs with a bias towards capital- and scale-intensive processes. On the processing side this translates into fewer and larger facilities and facilities with little flexibility to efficiently handle fluctuating levels of throughput. On the production side it points to continued efficiency advantages for larger farmers, making them the desirable trading partners in a coordinated agriculture. The trend among consumers to demand an ever wider set of characteristics in the food they consume is in our view the product of both increasing incomes and declining food budget shares and an increasing social awareness among consumers, neither of which is likely to abate over time.

Consumers are the big winners in vertically coordinated modern agricultural markets. They get access to an incredibly wide range of products reflective of their increasingly diverse tastes at low cost. The less efficient producers and intermediaries are the big losers. The market is never kind to inefficient operators, but in the past small farms could hang on in essence by undervaluing family labor, “consuming” the amenities of rural living, and selling into cash markets. In a vertically coordinated agriculture, such producers increasingly have trouble finding selling opportunities.

What can and should be done about these developments are difficult questions. Policies that attempt to put the brakes on these trends are misguided in our view because they detract from the efficiency of the market and make U.S. agriculture less competitive in the world. The

start to producing good policies is for policymakers and the agricultural economists whose research is input to the policy process to recognize that modern agricultural markets are not the quintessential open markets of days past and, moreover, never will be again. Research underpinned by such models is unlikely to be helpful, and policies tailored to such markets or intended to turn the tide back in their direction are likely to be counterproductive.

Endnotes

[1] The HHI is the sum of every firm's squared share of market value in an industry. Consider an example. Two industries, A and B, are each composed of five firms. Industry A's firms have the following percentage market shares: 50, 20, 10, 10, and 10, resulting in an HHI of 3,200. The five firms in industry B have percentage shares of 30, 20, 20, 20, and 10, resulting in an HHI of 2,200. The CR4 for both industries is 90 percent, but the higher HHI in industry A reflects the very large share of one of its firms.

[2] We emphasize that the national data and the NAICS industry classifications may not be deemed relevant markets for antitrust analysis in either product- or geographic-market contexts.

[3] Code 311312, cane sugar refining, has a reported CR4 of 95.2, suggesting its unreported HHI may be very high.

[4] This definitely seems to be true for steer and heifer processing where on Oct. 20, 2008, the DOJ filed a case alleging that the proposed acquisition by Brazilian cattle processor JBS of National Beef Packing Company would likely lessen competition in the purchase of fed cattle and in the sale of USDA-graded boxed beef to retailers. The parties subsequently abandoned the transaction.

[5] These concerns are reflected in two similar class action lawsuits filed on behalf of dairy farmer plaintiffs alleging that their cooperatives were colluding with processors in order to acquire or

maintain monopsony power in the market for the acquisition of raw fluid milk. Defendants and co-conspirators were alleged to have refused to purchase milk from independent dairy farmers, effectively forcing them to join a cooperative or a marketing services organization or have no buyer in the relevant geographic market for their milk (*Sweetwater Valley Farm, Inc. et al. v. Dean Foods Company et al.* 2008).

[6] The difference in the magnitude of the markdown estimates obtained in this study relative to predecessors may be due to a number of factors including its use of transactional-level data, analysis of a relatively small time period and specific geographic area, the use of an alternative method of oligopsony-power estimation, as well as simply the period of the data collection as discussed in Crespi, Xia, and Jones (2010).

[7] Most of the work on buyer power in agriculture has examined the meat packing industry but the studies available for other industries suggest that only modest buyer power exists in them as well. See for example Katchova, Sheldon and Miranda (2005) on potato procurement and Crespi, Gao and Hanawa Peterson (2005) on rice procurement.

[8]See for example studies by Hayenga (1998), McDonald et al. (2000), McDonald and Ollinger (2000), Morrison-Paul (2001), Ward (2002), and Muth et al. (2005).

[9] This latter point relates to the imperative in modern agricultural markets that a seller be able to *reliably* supply a consistent amount of product to its downstream buyers (Sexton 2013, in press).

[10] This linkage between the existence of highly specific assets for both farmers and processors and the transactions-cost benefits of vertical coordination is fully consistent with the views articulated by Williamson, one of the pioneers of transactions-cost economics. For example, Williamson (1986, p. 157) writes “the main factor that is responsible for vertical integration from

a transaction-cost point of view is asset specificity." For discussions on the links between transactions costs and vertical coordination in agricultural markets see Murrell (1983), Goodhue (1999), Hueth and Hennessy (2001), and Martinez (2002).

[11] This point is best seen by imagining a converse situation involving moderate oligopsony power among five equal-sized Cournot competitors. These buyers each have a rather signifcant short-run market power, especially given that the farm supply they face is highly inelastic. Full exercise of this oligopsony power will diminish return on farm investment and over time lead to exit. A buyer who chooses to preserve resources in the production sector by paying a price sufficient to generate at least a competitive return on farm investment internalizes only 20 percent of the benefit from her investment in long-run viability of farm production.

[12] This argument is fundamentally no different than the argument that cartels (cooperative agreements among sellers) tend to breakdown during periods of financial stress because the long-run benefits of abiding by a cartel agreement are dominated by the short-run gains from cheating on it (e.g., Levenstein and Suslow 2006). A contemporary example of breakdown of a cooperative agreement between a buyer and its suppliers might be the case of *Adams, et al. v. Pilgrim's Pride Corporation* (Civil Action No. 2:09-CV-397. Findings of Fact and Conclusions of Law, September 30, 2011), where the judge ruled that the defendant shuttered a processing facility, leaving contract growers without a market outlet, in an attempt to stem the decline in prices for processed chicken.

[13] The magnitude of efficiency gains from contract production can be large depending upon the particular market configuration. The hog market has created something of a natural experiment in this regard, given the rapid evolution of vertical coordination mechanisms in that industry. Key and McBride (2003) for example found efficiency gains to contract production of hogs

relative to arm's length spot exchange on the order of 20 percent. Wohlgenant (2010) found that inefficiencies created by banning packer ownership of hogs would reduce farm prices on the order of seven percent.

[14] See for example Alston, Sexton, and Zhang (1997), Sexton et al. (2007), and Saitone, Sexton, and Sexton (2008) for demonstrations of this point in the contexts of returns to farm research, impacts of trade liberalization, and distribution of benefits from the ethanol tax credit, respectively.

[15] S. 2141 would affect packers who slaughter more than 120,000 head per year and exempts cooperatives or entities owned by cooperatives from compliance.

[16] McCorriston and Sheldon (1997) and McCorriston (2002) discuss vertical restraint and contracting issues outside of the U.S.

[17] The 2008 Farm Bill also stipulated that the Secretary must establish criteria to determine whether "a live poultry dealer has provided reasonable notice to poultry growers of any suspension of delivery of birds under a poultry-growing arrangement," "when a requirement of additional capital investments over the life of a poultry growing arrangement or swine production contract constitutes a violation of the Act," and "if a live poultry dealer or swine contractor has provided a reasonable period of time for a poultry grower or swine production contract grower to remedy breach of contract that could lead to termination of the poultry growing arrangement or swine production contract."

[18] The House of Representatives' version of the 2012 Farm Bill (H.R. 6083) includes a provision to repeal the portions of the GIPSA regulations that were put into place February 7, 2012.

Table 1. Structural characteristics of agricultural procurement

1. The products are often bulky and/or perishable, causing shipping costs to be high, restricting the products' geographic mobility, and limiting farmers' access to only those buyers located close to the production site.
2. Processors' needs for agricultural products are highly specialized. Other inputs cannot normally be substituted for a given farm product, nor can the given farm product substitute readily for agricultural product inputs in alternative production processes.
3. Farmers are specialized to the supply of particular commodities through extensive investments in sunk assets. These assets represent exit barriers for farmers and cause raw product supply to be inelastic.
4. Marketing cooperatives or bargaining associations, institutions of seller power, are present or potentially present in the market.

Source: Rogers and Sexton (1994)

Table 2. 2007 Values and changes since 1997 in 6-digit NAICS industry sales and concentration

Code	Industry	Firms	Sales	CR4	HHI	Firms	Sales	CR4	HHI
		2007 Values				1997-2007 Change			
		(no.)	($ bill.)	(%)	(val.)	(%)	(%)	(%)	(%)
311111	Dog and cat food manufacturing	199	14.5	71	2,325	54	67	22	84
311119	Other animal food manufacturing	993	24.7	30.1	285	3	30	27	19
311211	Flour milling	172	9.8	54.5	831	-32	23	13	19
311212	Rice milling	58	2.8	45.6	776	4	20	-12	-13
311213	Malt manufacturing	17	0.8	73.2	1,536	-11	2	6	5
311221	Wet corn milling	33	12.0	83.8	2,338	10	42	17	55
311222	Soybean processing	68	19.3	81.5	1,931	58	37	2	-5
311223	Other oilseed processing	31	1.8	79.5	2,753	-3	4	19	28
311225	Fats and oils refining and blending	75	13.4	54.4	1,030	-18	75	48	71
311230	Breakfast cereal manufacturing	35	9.9	80.4	2,426	-27	8	-3	-1
311311	Sugarcane mills	16	1.9	66.1	1,428	-53	28	17	23
311312	Cane sugar refining	14	2.3	95.2	D	17	-28	-4	D
311313	Beet sugar manufacturing	12	3.2	81.5	2,259	50	18	-4	13
311320	Chocolate and confectionery manufacturing from cacao beans	154	4.4	59.1	1,276	1	18	-26	-50
311330	Confectionery manufacturing from purchased chocolate	1,050	9.7	63	1,548	32	24	-3	-3
311340	Nonchocolate confectionery manufacturing	411	5.7	38.2	501	-29	13	-6	-20
311411	Frozen fruit, juice, and vegetable manufacturing	148	10.7	41.1	587	-16	12	20	32
311412	Frozen specialty food manufacturing	360	14.3	29.4	374	-1	41	-27	-29
311421	Fruit and vegetable canning	537	21.0	24.4	255	-19	33	-2	-2
311422	Specialty canning	101	9.1	75.9	2,885	-17	13	13	33
311423	Dried and dehydrated food manufacturing	150	5.6	35.9	486	20	81	18	10
311511	Fluid milk manufacturing	280	33.5	46	1,075	-30	53	116	426
311512	Creamery butter manufacturing	23	2.1	78.9	2,283	-28	57	51	157
311513	Cheese manufacturing	341	33.2	31.5	379	-15	64	-9	-28
311514	Dry, condensed, and evaporated dairy product manufacturing	141	13.9	42	652	-17	51	-11	-20

continued.

Table 2. 2007 Values and changes since 1997 in 6-digit NAICS industry sales and concentration-continued

Code	Industry	Firms	Value	CR4	HHI	Firms	Value	CR4	HHI
		2007 Values				1997-2007 Change			
		(no.)	($ bill.)	(%)	(val.)	(%)	(%)	(%)	(%)
311520	Ice cream and frozen dessert manufacturing	347	8.8	52.7	954	-15	51	63	115
311611	Animal (except poultry) slaughtering	1,523	68.9	59.4	1,047	17	27	4	-2
311612	Meat processed from carcasses	1,237	37.2	27.9	258	6	53	37	50
311613	Rendering and meat byproduct processing	128	3.7	42.8	646	-7	44	14	13
311615	Poultry processing	324	50.2	45.7	738	26	58	13	10
311711	Seafood canning	83	1.0	58.1	1,255	-45	20	124	266
311712	Fresh and frozen seafood processing	481	10.0	28.3	319	-18	66	108	165
311811	Retail bakeries	6,101	3.4	3.7	7	-12	74	48	97
311812	Commercial bakeries	2,297	26.0	37.3	451	-4	21	-5	-24
311813	Frozen cakes, pies, and other pastries manufacturing	206	4.9	32.4	407	-8	97	-15	-26
311821	Cookie and cracker manufacturing	303	10.8	69.3	1,607	-6	9	16	16
311822	Flour mixes and dough manufacturing from purchased flour	240	6.3	35.1	553	17	26	-20	-47
311823	Dry pasta manufacturing	155	1.5	62.9	1,210	-38	-13	10	-8
311830	Tortilla manufacturing	329	2.6	57.4	1,865	52	133	0	1
311911	Roasted nuts and peanut butter manufacturing	188	6.8	33.5	413	47	73	-11	-25
311919	Other snack food manufacturing	286	17.5	D	D	-16	81	D	D
311920	Coffee and tea manufacturing	337	7.8	43.3	763	57	-2	-18	-26
311930	Flavoring syrup and concentrate manufacturing	150	9.2	D	D	1	39	D	D
311941	Mayonnaise, dressing, and other prepared sauce manufacturing	282	6.8	36.2	483	-4	17	-10	-26
311942	Spice and extract manufacturing	308	7.5	29.6	480	28	77	-32	-40
311991	Perishable prepared food manufacturing	612	8.3	27.8	273	47	204	14	21
311999	All other miscellaneous food manufacturing	759	10.8	18.7	168	-3	35	-20	-24
	Average	470	12.5	50.3	1,048	1	42	13	30
	Min	12	0.8	3.7	7	-53	-28	-32	-50
	Max	6,101	68.9	95.2	2,885	58	204	124	426
	Median	206	9.1	45.7	770	-4	35	6	8

Notes. D denotes an unreported value. For 2007, the CR8 for codes 311919 (other snack food) and 311930 (flavorings) were 77 and 84.4, respectively. CR4 is the four-firm concentration ratio. HHI is the Herfindahl index.

Table 3. Four-firm concentration ratio for selected meat packing industries, 1980-2010

Year	Steer & Heifer	Sheep & Lamb	Hog	Broiler	Turkey
1980	36	56	34	32*	40*
1995	81	72	46	46	45
2000	81	67	56	49	41
2001	80	66	57	48	55
2002	79	65	55	48	54
2003	80	65	64	55	54
2004	79	65	64	54	55
2005	80	70	64	53	54
2006	81	68	61	58	56
2007	80	70	65	57	51
2008	79	70	65	57	51
2009	81	70	63	53	58
2010	85	65	65	51	56
Percent Change 1980-2010	136%	16%	91%	59%	40%
Percent Change 1980-1995	125%	29%	35%	44%	13%
Percent Change 1995-2010	5%	-10%	41%	11%	24%

Notes: Unless otherwise noted, the source is Packers & Stockyards Program Annual Report, various years.

* indicates the 1982 value from Ollinger et al. (2000), as poultry is unreported in earlier packers and stockyards reports.

Table 4. Number of meat packing plants, 1980-2010

Year	Cattle	Sheep & Lamb	Hog
1980	743	195	509
1995	279	98	245
2000	190	62	185
2001	190	65	185
2002	170	55	175
2003	165	56	155
2004	175	57	165
2005	170	58	162
2006	165	55	160
2007	165	57	165
2008	135	52	125
2009	135	53	135
2010	135	59	130
Percent Change 1980-2010	-82%	-70%	-74%
Percent Change 1980-1995	-62%	-50%	-52%
Percent Change 1995-2010	-29%	-5%	-30%

Source: 1980 data are from the Packers and Stockyards Statistical Report (October 1996). 1995 data are from Packers & Stockyards Program (P&SP) 1995 Annual Report. In later years P&SP converted to graphical reporting only. 2000-2010 values are approximations from P&SP's graphical reporting in the P&SP 2011 Annual Report.

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