FEDERAL RESERVE BANK OF KANSAS CITY

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Special Issue 2017

Agricultural Consolidation: Causes and the Path Forward

Drivers of Consolidation and Structural Change in Production Agriculture

Concentration and Consolidation in the U.S. Food Supply Chain: The Latest Evidence and Implications for Consumers, Farmers, and Policymakers

Financing a Changing Agricultural and Rural Landscape

Consolidation, Concentration, and Competition in the Food System

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Foreword

In recent years, there has been an increasing intensity in consolidation among businesses connected to the agricultural sector. Faced with persistently low agricultural commodity prices and reduced profit margins, some businesses have explored structural changes as a means of strengthening profitability and creating opportunities for long-term growth.

Although consolidation has a long history in this sector, the current activity may be fundamentally changing the agricultural landscape in ways that have important implications for businesses, consumers, and communities. While the potential benefits of consolidation are well known, including the ability to exploit economies of scale, increase productivity, and foster new innovation, the risks may not be as readily apparent or well understood. Given the nature of these businesses and their important role in our regional, national, and global economy, it is increasingly important for policymakers to understand these issues and their potential implications for the future.

The Federal Reserve Bank of Kansas City hosted a symposium exploring the economic drivers, merits, and drawbacks of consolidation in agriculture, "Agricultural Consolidation: Causes and the Path Forward," on June 15 and 16, 2017. The articles in this volume are from that event, and it is my sincere hope that they will contribute to an ongoing dialogue on this issue and assist those who are responsible for making important business and policy decisions.

Esther L. George
President and Chief Executive Officer
Federal Reserve Bank of Kansas City

Drivers of Consolidation and Structural Change in Production Agriculture

By Michael Langemeier and Michael Boehlje

Although the production agricultural sector has historically been much more fragmented than other stages of the food and agricultural industry, it has been transitioning for decades from modestly sized, independent businesses to increasingly larger-scale businesses more tightly aligned across the value chain. In this article, we examine the key drivers likely to influence further consolidation and structural change in the next few years and discuss the implications of the key drivers for agribusinesses. Specifically, we discuss the importance of cost economies and the reconfiguration of the value chain to production agriculture. Because they are such basic concepts in a primarily commodity industry such as production agriculture—and, consequently, have a profound effect on almost all of the drivers of consolidation and structural change in that industry—we begin with a review of cost concepts and, in particular, economies of scale, economies of scope, and learning.

I. Cost Economies in Production Agriculture

Economies of scale exist when average cost per unit declines as output expands. Economies of scope exist when there are cost advantages

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associated with producing certain products together rather than separately. The learning curve slopes downward or leads to cost reductions when average cost declines as output increases over time. The subsequent discussion focuses on sources of cost economies rather than the current structure of U.S. agriculture. A discussion of the current structure of U.S. agriculture and definitions of farm size categories can be found in Box 1.

In capital-intensive industries or industries for which fixed costs represent a significant proportion of total cost, economies of scale are often evident (Rasmussen). In production agriculture, increases in farm size often lead to reductions in family and operator labor as well as machinery and building investment per unit of output. For example, for Illinois Farm Business Farm Management (FBFM) crop farms, machinery investment per acre was $640 per acre for 1,000 acre farms, $590 per acre for 2,000 acre farms, and $540 per acre for 3,000 acre farms in 2015 (Zwilling and others).

In production agriculture, technology adoption can foster economies of scale and competitive advantages for a couple of reasons. First, early adopters of technology often reap above average net returns. Second, in an industry with rapidly changing technology such as production agriculture, firms that do not adopt technology become increasingly inefficient. The production frontier for production agriculture, which represents the relationship between output and input, is rapidly shifting upward (Mugera and others). If firms adopt technology that is several years old because of size or capital constraints, their relative position may fall increasingly short of the production frontier.

Another potential source of economies of scale are advantages associated with buying inputs or selling outputs in relatively large quantities (specifically, pecuniary economies of scale). As farms grow, they may be in a position to purchase seed, fertilizer, agricultural chemicals, and machinery for a lower per unit price and more effectively negotiate land rental arrangements. In addition, larger farms may be in a better position to negotiate with grain and livestock buyers. Even small differences in input or output prices can make a large difference in production costs and profits.

Using key personnel more effectively may also provide a cost advantage for larger farms. As farms expand, operators and key

Box 1

Structure of U.S. Agriculture

A recent paper by Hoppe and MacDonald categorizes both the percentage of acres operated and the value of farm production by farm size. Small family farms have a gross cash farm income less than $350,000, midsize family farms have a gross cash farm income from $350,000 to $1,000,000, and large family farms have a gross cash farm income exceeding $1,000,000. Nonfamily farms refer to any farm where the operator and persons related to the operator do not own a majority of the business. Large family farms make up only 2.9 percent of total farms while operating 23 percent of acres and generating 42.4 percent of the value of production. Hoppe and MacDonald note that production has been shifting to larger farms for many years. In 2015, family and nonfamily farms with gross cash farm income over $1,000,000 accounted for approximately one-half of the value of farm production in the United States; in 1991, these farms accounted for only one-third of the value of farm production. In addition, the midpoint size for cropland in 1982 was approximately 600 acres, while the midpoint size in 2012 was approximately 1,200 acres. According to the Agricultural Resource Management Survey, in 2015, 69 percent of all farms had a profit margin below 10 percent. For farms with $1,000,000 to $5,000,000 in sales and greater than $5,000,000 in sales, only 36 percent and 26 percent of farms, respectively, had profit margins below 10 percent.

personnel have the opportunity to specialize. For example, larger farms may have an individual responsible for technology adoption, financial management, crop production, or personnel management. In contrast, on small farms, the operator may not be fully employed. On midsize farms, the operator or operators may wear many hats, and it is therefore more likely for some important strategic decision or area of responsibility to "fall through the cracks."

Besanko and others discuss several sources of diseconomies of scale. We examine these sources in the context of production agriculture. First, labor costs per worker are often positively related to firm size. In the production agriculture context, a larger farm may have to hire someone with expertise in financial management or personnel management. If the benefits from hiring this person do not outweigh the extra cost, then profit will not increase. Second, larger farms sometimes spread specialized resources too thin. This can be a problem on a rapidly growing farm. Indeed, we have certainly seen cases where one of the key farm operators or employees is spread especially thin. In these instances, it is important to bring in personnel to help relieve the managerial pressure. Third, bureaucracy can become a problem in larger firms. Most farms are not at the scale where bureaucracy is problematic. However, organization—specifically, how duties and responsibilities are divided between operators and key employees—can be contentious on larger farms.

Another possible source of diseconomies of scale in production agriculture is related to the timeliness of operations. As farms expand, it can become difficult to ensure that operations occur in a timely fashion. This is particularly true when farms expand rapidly. In these situations, farms may not have the necessary machinery or personnel in place for the first year or so. Careful strategic planning with regard to farm resources can help mitigate this issue.

As indicated previously, economies of scope exist when it is possible to produce outputs together rather than in separate firms. The classic example in production agriculture is producing crops and livestock on the same farm. In general, empirical research suggests that economies of scope are larger for smaller farms, as smaller farms produce multiple outputs (such as crops and beef) to use operator labor, machinery, and equipment more efficiently (Langemeier).

Learning curves are prevalent in manufacturing, and occur when average cost per unit produced declines with output over time. As a manufacturing firm becomes more familiar with producing a product, the cost per unit rapidly declines. In production agriculture, technology adoption is associated with a learning curve. Larger farms have a potential advantage, because they have more units with which to "try out" the new technology. In addition, larger farms are often beta testers of new technologies developed by agribusinesses, giving them an early look at how a specific technology may work on their farm.

The learning curve is often related to production costs. However, producing specialized products can also require (or benefit from) learning. For example, a farm familiar with producing popcorn will probably find it easier to negotiate contracts to produce waxy corn, white corn, or non-GMO corn.

II. Key Drivers Influencing Consolidation

Table 1 lists key drivers influencing future consolidation. This table represents an updated version of a figure contained in Boehlje and others. Each of the drivers is briefly discussed in the following subsections. It is important to note that many of the drivers are inter-related.

Capital and land market access

Larger farms have two advantages in terms of access to capital and the land market. First, financial performance tends to be relatively higher for larger farms (Hoppe and MacDonald). Relatedly, larger farms tend to have better recordkeeping systems and are more likely to produce accrual financial statements. Second, larger farms retain higher earnings due to their relatively higher financial performance and lower payout ratios (that is, lower operator withdrawals as a percentage of profit). Due to their enhanced ability to purchase machinery and equipment—and in many instances hire additional labor—larger farms are often better positioned to rent additional farmland. According to Hoppe, larger farms also tend to have multiple operators and multiple generations, creating more of an incentive to expand the operation (Hoppe).

Table 1
Key Drivers Influencing Consolidation

Driver	Small farms	Midsize farms	Large farms
Capital and labor market access	0	0	+
Cost economies	–	0	++
Government payments and limits	0	0	–
Managerial resources	0	0	+
Off-farm employment opportunities	+	0	0
Profitability and growth focus	– –	–	+
Risk	0	0	+
Technology	–	+	++
Value chain alliances	+	+	++

Key:
– – Strong disadvantage
– Disadvantage
0 Neutral
+ Advantage
++ Strong advantage
Note: Updated version of a figure contained in Boehlje and others (2005).

Cost economies

Larger farms will continue to exploit scale economies in the future due to differences in technology use and pecuniary economies associated with higher selling prices and lower purchasing prices. Pecuniary economies will be related to the volume of inputs purchased and the enhanced opportunities to participate in specialized production contracts or alliances associated with changes in the value chain. Many large farms are already engaging in at least one specialized crop or livestock enterprise, making it easier for them to explore other contract opportunities or strategic alliances.

Government payments and limits

Government payments pertaining to conservation, crop programs (for example, the Agriculture Risk Coverage-County program), dairy programs, and crop insurance enhance income and mitigate downside risk. Depending on the program, the government places limits or restrictions on the parties that can receive payments as well as the amount of the payments themselves. Payment limits typically have a greater effect on larger farms than they do on small and midsize farms.

However, a small or midsize farm may face restrictions in some instances due to the amount of nonfarm income they earn.

Managerial resources

As farms continue to grow, capital needs increase, risk management becomes increasingly important, and technology adoption—particularly of labor-saving technologies—has a greater influence on competitive advantage. Because large farms often have multiple operators and generations, they are more likely to have individuals with the pertinent skills in key areas (for example, financial management, risk management, and technology adoption) and to assign point people to these key areas.

Off-farm employment opportunities

Employment opportunities vary across the country, but in general are available to farms of all sizes. Small and midsize farms tend to garner a large portion of their income from off-farm employment (Hoppe and MacDonald). These opportunities often make it possible for small and midsize farms to engage in production agriculture.

Profitability and growth focus

Values and goals often differ by farm size and whether the operators are part-time or full-time operators. Due to economies of scale and lower withdrawals as a percentage of profit, larger farms have more retained earnings that can be used to reinvest and grow the farm business. Midsize farms often do not have sufficient retained earnings after withdrawals to grow the farm business. Small farms, which are often operated by part-time operators, typically have motivations other than profit, and thus do not focus as much as larger farms on profitability and growth.

Boehlje indicates that both economies of scale and managerial motivations are critical to explaining farm growth and consolidation. The author notes that consolidation and concentration is a "natural" phenomenon. Economies of scale provide an impetus for farm growth. However, economies of scale are not the sole driver of farm consolidation. In addition to lower per-unit costs, larger farms also have higher output levels and higher profits. The use of these higher profits is as

important in understanding the growth of successful farms as economies of scale. Withdrawals to business owners account for a higher percentage of small and midsize farms' annual profits compared with larger farms. Larger farms have lower payout ratios and higher retained earnings which can be used to reinvest in the business (in other words, larger farms have faster growth rates). In essence, larger farms have more "natural" growth potential because of their higher levels of retained earnings.

Organic or internal growth is a traditional approach to expansion in production agriculture. In this approach or business model, farms acquire assets and add them to the current business. Boehlje describes seven additional business models that producers can use: mergers and acquisitions, franchising, strategic alliances, service provider, asset or service outsourcing, entrepreneur, and investor. Many of these seven additional types of business models are relatively new options for agricultural producers. If adopted, these alternative business models could dramatically change the structure of U.S. agriculture.

Risk

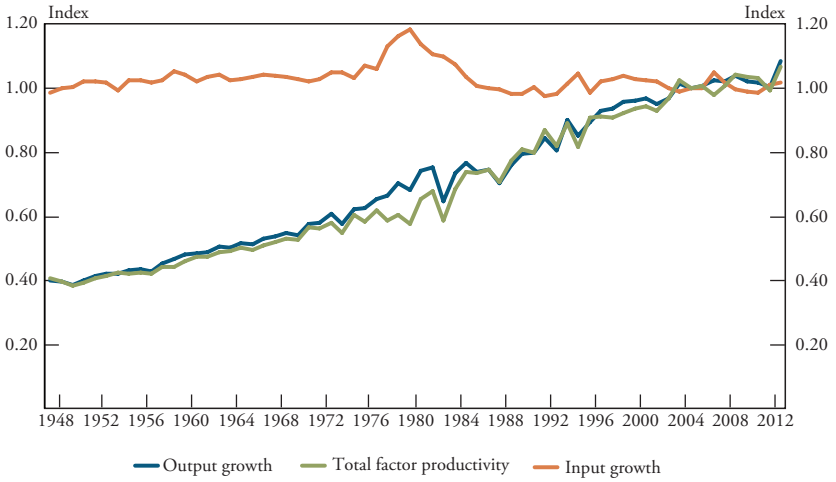
Many risk instruments, such as hedging, forward pricing, crop insurance, and contracts, are available to most farms. However, larger farms are more likely to use these instruments, as they can assign a point person to assess risk management options. Effective use of risk instruments increases a farm's ability to obtain credit and expand their operation. The increasing use of contracts to produce specialized products will mitigate risk in the production agricultural sector. However, to the extent that contract use varies among farm size categories, the trend toward more contract use will create important differences in price risk exposure.

Technology

Production agriculture has been substituting capital for labor for decades. Chart 1 illustrates trends in output growth, input growth, and total factor productivity, while Chart 2 illustrates trends in labor, purchased inputs, and capital from 1948 to 2013 (USDA-ERS). On average, output growth (1.52 percent per year) was almost entirely due to total factor productivity growth (1.47 percent per year). Over the 1948 to 2013 period, labor use declined 2.22 percent per year, purchased

Chart 1

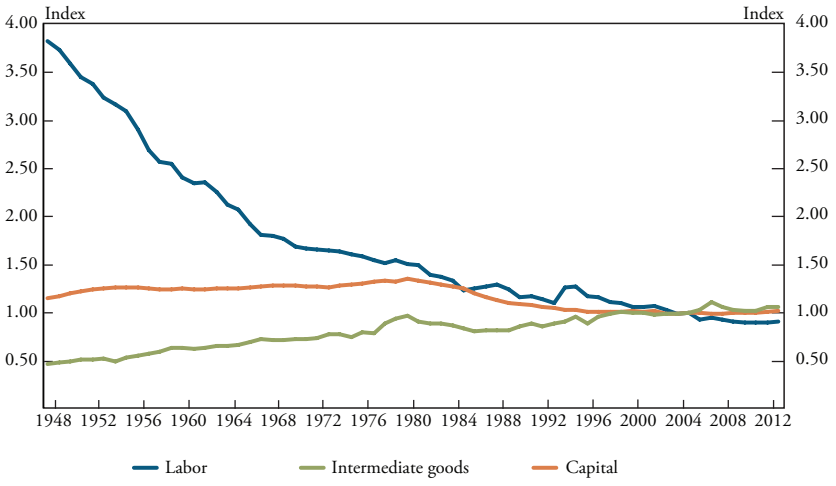
Output Growth, Input Growth, and Total Factor Productivity, U.S. Farms



Source: USDA-ERS (2017).

Chart 2

Sources of Input Growth, U.S. Farms



Source: USDA-ERS (2017).

input use increased 1.26 percent per year, and capital use decreased 0.18 percent per year. Purchased or intermediate inputs include feed and seed, energy, fertilizer and lime, pesticides, and purchased services. Capital inputs include durable equipment, buildings, land, and inventories. The decline in capital use is due to the decline in land used for production. It is important to note that in most of the relevant research, capital includes both capital assets (for example, equipment, buildings, and land) as well as purchased inputs.

Another way to think about the large change in output growth (1.47 percent) in relation to the small change in input growth (0.05 percent per year) is that farms are obtaining increasingly higher output levels for the same level of inputs. In other words, the production frontier is shifting upward. Mugera and others illustrate the large shift in the production frontier for a sample of farms from 1993 to 2010. Due to their inability to keep up with the farms on the production frontier, many of the sample farms saw their relative efficiency decline over the 1993 to 2010 period. Despite adopting new technologies, these farms are falling further behind their counterparts.

The upward shift in the production frontier will almost certainly continue. Indeed, many individuals suggest we are on the cusp of another technology revolution (see, for example, Brynjolfsson and McAfee). This second machine age will expand our use of robots, artificial intelligence, and data analysis. Baily and others discuss technological innovations that are going to transform manufacturing. These transformations, which include industrial robotics, 3-D printing, and big data (see Box 2) will also have important ramifications for production agriculture.

Large farms are well positioned to adopt new technologies. As noted previously, large farms tend to have higher profit margins and retained earnings, increasing the speed with which they can adopt new technologies with benefits that exceed their costs. Larger farms also have the ability to assign one or more individuals specifically to the adoption of new technology. Going forward, robotics and big data will require additional managerial expertise. Small and midsize farms, which are typically operated by sole proprietors, will find it more difficult to reallocate time towards the adoption of these new technologies.

Box 2

Robotics, 3-D Printing, and Big Data

Robotics (specifically, automation), 3-D printing, and big data are likely to revolutionize technology in the near future. Baily and others contend that these innovations may be large enough to have significant effects on manufacturing productivity. Similar arguments can be made for production agriculture.

Chui and others indicate that automation, at least in the next decade, will not necessarily eliminate entire occupations. However, automation is likely to affect portions of almost all jobs. The authors identify three groups of occupational activities: those that are highly susceptible to automation, less susceptible to automation, and least susceptible to automation. Highly susceptible technologies include data processing and predictable physical work. Least susceptible technologies include personnel management and decision-making, planning, and creative tasks. At least a portion of the activities in production agriculture fit into the categories of data processing and predictable physical work. Robotic milking systems offer one example of a technology that is expanding in agriculture. Salfer and others estimate that there are over 35,000 robotic milking systems worldwide. The adoption of these systems is being driven by productivity enhancements and labor savings.

3-D printing also has important implications for production agriculture. 3-D printers will allow machinery dealers and producers to rapidly manufacture spare parts. This technology will likely change how we think about manufacturing batch size and inventories, and will allow parts to be just-in-time, which could substantially reduce machine downtime.

The use of big data tools in production agriculture will likely influence the nature of competition and inter-firm relationships (Sonka). Value is expected to be created through the application of tools to measure and monitor activities; data analytics, which

Box 2 (continued)
can integrate and analyze data from multiple sources; and the creation of data sources that can help mitigate detrimental environmental effects. Incentives will be in place for producers to create big data system alliances with both input suppliers and first handlers of agricultural products. In addition, big data is helping reconfigure the value chain, creating opportunities for farms to add value to their products.

Value chain alliances

Moving from commodity production to more differentiated products will create opportunities for farms of all sizes. Changes in the value chain will give producers a broader set of production choices. Producing differentiated products should enhance income and mitigate risk to the extent that producers capture a portion of the additional value associated with these products.

Many differentiated products start out requiring small acreages or small animal numbers. However, as the demand for a differentiated product expands, the product tends to become "commoditized." Economies of scale and managerial resources will likely improve the relative position of larger farms when it comes to growing products for reconfigured value chains.

III. Reconfiguring the Value Chain

Competitive advantage can result from product differentiation or from being a low-cost producer (Besanko and others). A low-cost producer, as the term implies, strives to have below average per unit costs while receiving at least average product prices. A farm pursuing product differentiation, on the other hand, strives to obtain above average per unit product prices while maintaining a cost structure that is at least average. The previous discussion focused on production costs—a warranted emphasis, given the historical importance of being a low-cost producer to a farm's competitive advantage. However, the current reconfiguration of the value chain is going to place an increasing emphasis on product differentiation.

One of the major changes in the food and agribusiness sectors that is affecting farms is the restructuring or reconfiguring of the value or supply chain. Restructuring affects the linkages among activities and processes from genetics and breeding through input manufacturing and retailing, production handling and processing, and food wholesaling and retailing to final consumers.

In the past, production agriculture has been dominated by commodity production. But a significant trend in today's agriculture is the development of differentiated products, with some of that differentiation occurring within the farm gate. The traditional supply chain took standard farm crop and livestock products, performed numerous processes, and then moved the final products to a retailer or food supplier. In this system, much of the work to produce the characteristics that food consumers wanted was done by businesses past the farm gate: after the farmer, products went to the local grain elevator who then shipped it to the processor who delivered the commodities. As consumers have increasingly demanded more unique or differentiated food products—some of which have been developed before the processing stage, such as organic food, or the use of appropriate animal treatment or welfare practices—multiple and often more complex value chains have been developed to transform the production inputs into consumer food products.

More tightly aligned supply chains facilitate product differentiation, and the opportunity to differentiate incentivizes chain formation. The need for diversity, exacting quality control, and flow control taxes the ability of open commodity markets to effectively coordinate production and processing. Traditional open markets increasingly encounter difficulties conveying the full message concerning attributes of a product and characteristics of a transaction. Where open markets fail to achieve the needed coordination, other options such as contracts, alliances, vertical integration, or joint ventures will be used. The transition to this new business model has occurred to a large degree in the poultry, pork, beef feeding, and dairy industries, and it is increasingly occurring in the crop industries (for example, vegetable and seed production, white corn, waxy corn, organic or non-GMO corn and soybeans, and high oleic acid soybeans).

What are the implications of these structural changes to farms? First and most obviously, the business model for participating in these more tightly aligned value chains will be different than for traditional commodity production. Producers will need to be more responsive to customer demand and expectations, provide better documentation of what processes and inputs they are using, emphasize quality as much quantity, and be more precise in their production activities to biologically manufacture specific attribute raw materials for particular end-users (rather than just "growing stuff").

Some consumers will want to know more about the grower, the inputs used in production, and the processes employed. Technology is increasing the likelihood that the supply chain can offer this detail in a cost-effective manner. Technology has increased the precision of farming as it moves down through the supply chain. Management information systems will improve communication among all links in the value chain.

Producers will need to be careful in their choice of buyers and suppliers to make sure they are participating in a value chain that is sustainable in the long run and provides acceptable rewards while sharing the risks of agricultural production. Producers will have a different and, in many cases, broader set of choices than in traditional commodity production. Specifically, they have the potential to participate in value chains that produce differentiated products and to capture some of the additional value that is created in these markets. However, they also will likely need to be larger in scale to "count" to their buyer and to be responsive to their buyers' expectations. In addition, they must always be searching for new opportunities—almost all differentiation is commoditized over time as initial higher margins decline—so producers are now on an additional treadmill of constantly assessing new product or service opportunities to offer, much like the historical technology treadmill of what new technology or production processes to use in traditional agriculture.

IV. Implications for Agribusinesses

What do the dramatic changes in the structure of production agriculture mean for agribusiness input suppliers and product purchasers? How will the farm customer base change in the future in terms of size, resource control, and buying and selling behavior? How might the

customer segments be characterized in terms of size, numbers, and volume produced? How might attributes such as price, service, convenience, and product performance be considered and valued in the producer's purchasing and selling behavior? And how will these structural changes affect the marketing strategies of product purchasers and input manufacturers and distributors? We attempt to address these questions in the subsequent discussion.

Customer relationships

Suppliers and buyers will face a much less homogeneous customer base in the future. Individual accounts will vary not only in size, but also in product and service requirements. As a whole, customers are likely to be more focused, informed, and business-savvy. In addition, tighter vertical linkages from alliances, partnerships, and ownership will expand and complicate the traditional definition of the customer. Complex business relationships and "teams" at different ends of the marketing channel could have similar effects.

Key accounts will be vitally important, making customer loyalty extremely valuable. Efforts that build loyalty by rewarding the most valuable customers will likely pay high dividends. Customer loyalty cards are a means to this end, and we might expect similar strategies to appear within wholesale markets. Trust will be ever more important in both business and customer relations. Indeed, trust is a prerequisite for the tighter vertical and horizontal relationships we foresee between firms, and it is an important part of the process of building and maintaining customer confidence in a safe food supply.

Products and services

Farms will increasingly expect and demand total solutions to their unique business problems. The focus will be not only on agronomic or nutritional responses to crop and livestock production problems, but also on systems solutions to crop and livestock profitability. The fundamental issue will be whether a particular supplier provides a total system solution or only selected components of that solution. In addition, if only selected components are provided, the customer will more than likely expect recommendations for the other components as well as advice on the compatibility (or lack thereof) between the components provided and those obtained elsewhere.

A total system approach will likely involve suppliers offering a broader product or service package or increased business linkages between component products and service providers. Moreover, increasing customer expectations will likely increase demand for customized products and specialized inputs.

The rate of change and pace of innovation in new products and services and product and service packaging will be rapid. More non-traditional services will be identified and provided. Innovation in services and packaging may be more rapid than product innovation. Information and the conversion of data to profitable decisions will likely be at the core of many service innovations.

Risk reduction may become part of the product package through the more prevalent use of warranties and guarantees. Contracts may play a role here: much like fee-based contract growing of hogs or poultry, net income per acre contracting of grain production is possible. In addition, input suppliers may increasingly offer product marketing as part of their product or service package. For example, a specialized package of inputs for producers of specialty crops and livestock might include some type of marketing contract or linkage to assure producers an outlet for their product.

Pricing strategies

Expect a more informed and demanding customer base to lead to competitive price pressures. Pricing strategies that create loyalty will be ever more important, pricing strategies that reduce (or share) risk will likely be embraced, and contractual pricing of products and services will likely become more common. In addition, pricing strategies that transfer risk to third parties might also become more common. Such strategies allow customers to lock in costs in advance while transferring the price volatility to retailers who might be better positioned to transfer or manage them. Expect less pricing based on each transaction, and more pricing based on "lifetime" service. Finally, expect innovative pricing arrangements such as technology fees to become increasingly common.

Distribution strategies

The flow of raw materials, products, and information across the marketing channel will become more efficient, increasing the pressure on the "middleman" or distributor. Dealers and distributors may need

to find new ways to add value to remain viable business entities. A potential new role is that of a "deal maker" between the producer and the other parts of the marketing channel. Direct selling from the manufacturer to the producer will likely increase.

Relationships in the channel may be based more on pay-for-service arrangements, where specific players are compensated for the functions they perform and no more. Better inventory management and control will lead to significant cost savings and be expected of all businesses in the industry. The internet and electronic data interchange will play a major role in tightening linkages across the channel.

Communication strategies

Technology continues to make communication easier across geographic boundaries. Storing and collecting information about the marketplace and individual customers has also become easier over time. Customer databases will continue to grow into the future, providing greater opportunities for direct marketing of products and services.

The internet presents global marketing opportunities while simultaneously introducing global competition from distant firms. Electronic data transfer and the extremely rapid movement of information will make managing communications more challenging: problems will still be "coffee shop talk," but when producers can circulate opinions over the internet, the whole world becomes the coffee shop.

Communication strategies in general will be far more tailored and make heavy use of databases and electronic communication technologies. Personalized messages and messaging technology will allow individual messages to be delivered to individual customers. Communication with end-users will stretch firms to become familiar with a new set of decision processes, and highly technical sales abilities such as engineering, chemistry, or food sciences will be key to success with these targets. Team-based selling and field marketing concepts (local responsibility and authority) will be even more prevalent given the changing producers and customers.

V. Conclusions and Implications

In this article, we examine the most likely drivers of consolidation in the next few years and discuss the implications of changes

in the structure of production agriculture for agribusinesses. Key drivers influencing farm consolidation include capital and land market access, cost economies, government payments and limits, managerial resources, off-farm employment opportunities, profitability and growth focus, risk, and value-chain alliances. Current trends in these key drivers favor continued farm consolidation.

Due to anticipated changes in technology and production practices, required managerial expertise, and the value chain, production agriculture is in the midst of a major transformation. Forces driving this transformation are many and widespread including increased quality, safety and traceability demands of food processors and consumers; implementation of information and process control technologies that facilitate biological manufacturing of crop and livestock products; adoption of technologies and business practices that exploit economies of scale; increased use of leasing and other outsourcing strategies to foster growth and expand options for resource control; and wider adoption of contracting, strategic alliances, and cooperative business models to facilitate more effective and efficient vertical coordination with buyers and suppliers in the production/distribution value chain. Both the crop and livestock sectors are changing from an industry dominated by smaller, family-based, relatively independent firms to an industry dominated by larger businesses more tightly aligned across the value chain.

We focus on factors leading to consolidation in production agriculture and the implications of this consolidation for agribusinesses. For several reasons, farms of various sizes will likely continue to exist even absent constant returns. These reasons include firm-household relationships; family-furnished resources; constant costs and labor techniques; expectations of returns, capital limitations, and size; and exposure to uncertainty (Heady). Many of these reasons are still as important today as they were in the early 1950s. Many small farms are willing to earn low returns and secure income from other sources. In addition, numerous small farms, particularly those with younger operators, have long-run expectations of becoming larger and thus lowering per-unit costs. Finally, the nature of small farms' capital/labor ratios and debt levels makes at least a portion of these farms very resilient to downturns.

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Concentration and Consolidation in the U.S. Food Supply Chain: The Latest Evidence and Implications for Consumers, Farmers, and Policymakers

By Tina L. Saitone and Richard J. Sexton

Today's global food system faces the challenge of feeding a population of 7.4 billion that is expected to grow to 11.2 billion by 2100 while supplying an important and perhaps increasing proportion of our fuel needs. Further, modern agriculture is being asked to provide an increasingly complex suite of differentiated products that address issues rarely considered not long ago, such as the nature of inputs into the production process (for example, whether to use genetic engineering), the location of production, the environmental implications of production, the treatment of livestock used in production, and the "fairness" of marketing arrangements to farmers and farm workers.

Despite the seeming potential for today's multicharacteristic agriculture to create profitable niches for small-scale food marketers, food manufacturers in many industries are highly concentrated. This is especially true for farm-product procurement, joined more recently by significant consolidation among grocers and high concentration in local retail markets. These structural conditions are concerning because of their possible implications for market power abuses, the viability of small farms, and overall system performance.

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In addition, the food system has seen increasing vertical coordination across the stages of the supply chain. Such coordination is tied inexorably to the capital intensity of agriculture, processors' needs to secure stable supplies of farm inputs ex ante, and the market's demands for increasingly complex, multidimensional products that require close coordination across stages in the supply chain. Contract production dominates modern agriculture in key sectors such as fruit, vegetable, nut, and livestock production. These developments, too, have been a concern for some farm groups and policymakers due to farmers being locked in to particular buyers and to the implications of contract agriculture for small farmers and the vitality of rural America.

In this paper, we assess the current structure of the U.S. food and agriculture supply chain, focusing on concentration at the food manufacturing and retailing levels and coordination across vertical stages. We evaluate the performance of the food-marketing sector in meeting the challenges facing it and consider the implications of various policy proposals that have been put forth to guide the industry's evolution. Our focus throughout is on sectors downstream from the farm, namely food processing, distribution, and retailing. Although our analysis has implications for the structure of farming itself, we do not directly address structural changes at the farm level. Finally, we do not address the input-providing sectors upstream from the farm, even though the power of these firms, most notably in the seed sector, has been a point of contention. The issues here are highly complex, including intellectual property rights, and worthy of a separate treatment.

I. Some Historical Perspective

Textbook characterizations of agricultural industries as competitive based on large numbers of farmers and consumers ignore conditions in the food marketing sector, which determines on average 80 percent or more of product value. Issues pertaining to concentration and competition have long been important dimensions of agricultural markets, as have policymakers' concerns about powerful market intermediaries exploiting farmers and consumers. A key early example is a 1919 U.S. Federal Trade Commission (FTC) study of the red-meat packing industry and its so-called "big five" processing firms. The report accused the industry of manipulating markets, restricting throughput, harming

producers and consumers, and eliminating competition. It provided a direct impetus for the Packers and Stockyards Act of 1921.

Research on concentration and market power in agriculture, however, began in earnest with Clodius and Mueller's influential article applying the structure-conduct-performance (SCP) framework to food industries. Clodius and Mueller identified the key strategic structural characteristics of markets as (i) the number and size distribution of buyers and sellers, (ii) the extent of product differentiation, and (iii) the conditions of entry. They then presumed structure to determine market conduct, defined to include price and output decisions, the determination of product characteristics, policies on product promotion, and nature of interactions with rival firms or entrants. Conduct, in turn, was presumed to determine market performance, including the price-average cost margin, production efficiency, relative promotion expenditures, the design/quality of products, and industry innovation.

The causal linkage from structure to conduct to performance was theorized to hold broadly across industries. In contrast to the early research that focused predominantly on the influence of buyer power on farmers, researchers using the SCP framework were more interested in seller power and its influence on consumers. The pinnacle of these analyses was the publication of books by Connor and others and by Marion. Both books advocated extensive government regulation and oversight of the food industry. Connor and others concluded that food manufacturers' oligopoly power caused consumers to pay from six to 10 percent more for food due in roughly equal parts to overcharges, excessive selling costs, and excessive factor payments.[1]

The next wave of research on competition in agricultural markets focused on estimating structural models of single industries hypothesized to be characterized by market power—a stark contrast to the cross-industry approach used by practitioners of the SCP paradigm. These so-called "new empirical industrial organization" studies sought to estimate the key parameters characterizing an industry's behavior, including its extent of buyer and seller market power. In marked contrast with the SCP paradigm, these studies generally found quantitatively small departures from competition in both procurement and selling in agricultural markets and concluded that the efficiency advantages of consolidation outweighed any negative implications due to the exercise of modest market power (Azzam and Schroeter; Morrison-Paul).

Sheldon and Sperling, Suzuki and Kaiser, and the U.S. Government Accountability Office (GAO) echo this conclusion. In the words of the GAO:

> 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. 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.

These conclusions should not, however, be accepted uncritically. The econometric methodologies underlying many of the single-industry studies have received significant criticism (Corts; Perloff, Karp, and Golan). The "industries" analyzed were often based on conveniently available data rather than any serious attempt to identify relevant geographic and product markets. Furthermore, researchers often began with a maintained hypothesis of perfect competition, which the weak significance of empirical results failed to reject (Saitone and Sexton).

Recommendations for competition policy in agriculture that emerged during this era tended to be more modest than the activist policy recommendations that emerged from the SCP framework. For example, in 1996, the primary recommendation of the USDA Advisory Committee on Agricultural Concentration was for enhanced disclosure and reporting of information. However, other recommendations have been debated in the past several farm bills, most notably those that would restrict vertical relations between farmers and downstream buyers (Saitone and Sexton). These policies could have significant effects on markets, a topic we address later in this paper.

II. What is the Latest Information on Market Structure in Agriculture?

Crespi, Saitone, and Sexton use Economic Census data to distill trends in concentration in food manufacturing industries from 1997 to 2007. Their study updates earlier work on this topic by Rogers and Sexton. In Table 1, we update the Crespi, Saitone, and Sexton analysis to 2012 using the most recent quinquennial Census report on concentration in manufacturing. The most disaggregated industry classification

Table 1

2012 Values and Changes since 2007 in Six-Digit NAICS Industry Sales and Concentration

Code	Industry	2012 Values				2007–12 Change			
		Firms (number)	Sales (billions)	CR4 (percent)	HHI (value)	Firms (percent)	Sales (percent)	CR4 (percent)	HHI (percent)
311111	Dog and cat food manufacturing	233	21.5	67.8	2,019	17	48	–5	–13
311119	Other animal food manufacturing	876	36.4	24.3	228	–12	47	–19	–20
311211	Flour milling	168	15.1	50.3	772	–2	54	–8	–7
311212	Rice milling	49	3.9	46.6	778	–16	39	2	0
311213	Malt manufacturing	19	1.4	71.2	-	12	75	–3	-
311221	Wet corn milling	31	13.0	86.4	2,163	–6	8	3	–7
311225	Fats and oils refining and blending	89	16.8	55.3	1,098	19	25	2	7
311230	Breakfast cereal manufacturing	37	10.8	79.2	2,333	6	9	–1	–4
311313	Beet sugar manufacturing	14	4.7	77.5	-	17	47	–5	-
311340	Nonchocolate confectionery manufacturing	423	7.7	40.9	585	3	35	7	17
311351	Chocolate and confectionery manufacturing from cacao beans	156	4.3	54.7	998	1	–2	–7	–22
311352	Confectionery manufacturing from purchased chocolate	1,086	10.5	57.7	1,332	3	8	–8	–14
311411	Frozen fruit, juice, and vegetable manufacturing	144	12.2	45.5	739	–3	14	11	26
311412	Frozen specialty food manufacturing	400	18.1	35.1	567	11	27	19	52
311421	Fruit and vegetable canning	571	23.5	20.4	226	6	12	–16	–11
311422	Specialty canning	100	9.5	74.4	3,149	–1	4	–2	9
311423	Dried and dehydrated food manufacturing	169	6.6	35.0	570	13	18	–3	17

Table 1 (continued)

Code	Industry	2012 Values				2007–12 Change			
		Firms (number)	Sales (billions)	CR4 (percent)	HHI (value)	Firms (percent)	Sales (percent)	CR4 (percent)	HHI (percent)
311511	Fluid milk manufacturing	248	36.7	46.3	1,205	–11	10	1	12
311512	Creamery butter manufacturing	29	2.9	74.6	2,245	26	38	–5	–2
311513	Cheese manufacturing	390	41.2	29.9	374	14	24	–5	–1
311514	Dry, condensed, and evaporated dairy product manufacturing	133	19.5	44.0	687	–6	40	5	5
311520	Ice cream and frozen dessert manufacturing	343	7.0	45.9	666	–1	–20	–13	–30
311611	Animal (except poultry) slaughtering	1,420	91.8	60.7	1,085	–7	33	2	4
311612	Meat processed from carcasses	1,204	44.4	32.8	332	–3	19	18	29
311613	Rendering and meat byproduct processing	115	5.3	44.5	673	–10	43	4	4
311615	Poultry processing	319	58.0	39.8	600	–2	16	–13	–19
311811	Retail bakeries	6,339	3.1	4.7	12	4	–9	27	66
311812	Commercial bakeries	2,342	28.1	41.2	637	2	8	10	41
311813	Frozen cakes, pies, and other pastries manufacturing	210	5.6	30.3	389	2	14	–6	–4
311821	Cookie and cracker manufacturing	301	11.5	59.8	1,357	–1	6	–14	–16
311830	Tortilla manufacturing	334	3.7	60.2	1,970	2	42	5	6
311911	Roasted nuts and peanut butter manufacturing	215	11.1	31.0	400	14	63	–7	–3
311919	Other snack food manufacturing	303	20.6	73.9	4,262	6	18	-	-
311920	Coffee and tea manufacturing	417	13.2	57.5	1,283	24	69	33	68
311930	Flavoring syrup and concentrate manufacturing	131	8.8	74.6	4,047	–13	–4	-	-
311941	Mayonnaise, dressing, and other prepared sauce manufacturing	283	10.0	39.8	555	0	47	10	15

Table 1 (continued)

Code	Industry	Firms (number)	Sales (billions)	CR4 (percent)	HHI (value)	Firms (percent)	Sales (percent)	CR4 (percent)	HHI (percent)
311942	Spice and extract manufacturing	334	9.2	32.4	559	8	23	9	16
311991	Perishable prepared food manufacturing	640	10.2	29.6	338	5	23	6	24
311999	All other miscellaneous food manufacturing	537	11.5	27.8	284	–29	6	49	69
Average		542.4	17.2	48.8	1,122.1	0.7	22.7	2.8	13.2
Minimum		14.0	1.4	4.7	11.6	16.7	75.0	27.0	65.7
Maximum		6,339.0	91.8	86.4	4,262.0	3.9	33.2	3.1	47.7
Median		283.0	11.1	45.9	687.0	0.4	14.4	6.0	–6.9

Source: Economic Census of the United States (2007: ECO731SR12, 2012: EC1213SR2).

statistics for which detailed concentration data are available are six-digit North American Industrial Classification System (NAICS) codes. One problem in working with these national Census data is that the six-digit NAICS codes may not comprise relevant geographic or product-form markets for studying competition in either farm or consumer products.[2]

Table 1 includes the 2007 and 2012 values and 2007–12 percent changes by industry for number of firms, total value of shipments, four-firm concentration ratio (CR4), and Herfindahl-Hirschman Index (HHI).[3] The bottom of the table includes summary statistics on concentration measures to facilitate comparison with Crespi, Saitone, and Sexton.

From 1997 to 2007, food manufacturing concentration stabilized, as Crespi, Saitone, and Sexton noted, and the subsequent five years have followed a similar pattern. In 2012, the average CR4 and HHI across agricultural manufacturing industries in the United States were 48.8 and 1,122.1, respectively. Based on simple averages across the 37 NAICS-6 industries, the HHI increased by 13.2 percent and CR4 by only 2.8 percent.

The U.S. Department of Justice (DOJ) Horizontal Merger Guidelines (2010b) classify industries according to HHI as follows: (i) unconcentrated—HHI of less than 1,500, (ii) moderately concentrated—HHI between 1,500 and 2,500, and (iii) highly concentrated—HHI above 2,500. Based on these guidelines, 29 of the 37 industries included in Table 1 would be considered unconcentrated, five would be considered moderately concentrated (dog and cat food manufacturing (311111), wet corn milling (311221), breakfast cereal manufacturing (311230), creamery butter manufacturing (311512), and tortilla manufacturing (311830)), and only three would be considered highly concentrated (specialty canning (311422), flavoring syrup and concentrate manufacturing (311930), and other snack food manufacturing (311919)).[4] The largest increases in HHI from 2007 to 2012 occurred in coffee and tea manufacturing (311920) and all other miscellaneous food manufacturing (311999).

The animal (except poultry) slaughtering industry (NAICS 311611) illustrates the perils of using straightforward national Census statistics to analyze market power and market concentration in agriculture. That industry experienced a small (2 percent) increase in its HHI from 2007

to 2012 and had a HHI (CR4) of 1,085 (60.7) in 2012. Concentration in poultry processing declined from 2007 to 2012 and had a HHI (CR4) of 600 (39.8) in 2012. Both industries thus appear to be relatively unconcentrated. However, both poultry and non-poultry slaughtering have been the subject of much debate regarding producer-processor relationships, with several policy recommendations and proposed regulations designed to restrict the purchasing practices of these processors.

The national measures of concentration provided by the NAICS-6 statistics are likely irrelevant to any agricultural product procurement market. Most farm products are bulky and perishable, making them difficult and expensive to transport; as a result, most procurement markets are local or, at best, regional in geographic scope. National concentration measures may drastically understate concentration in specific procurement markets.

The NAICS-6 codes also usually fail to identify relevant markets for procurement in terms of product form. Plants are highly specialized to particular products, so while there is at least the possibility that meat products emanating from NAICS 311611 substitute significantly enough on the consumer side to be classified in the same market, the animals entering these facilities—cattle, hogs, and sheep and lambs—do not substitute as inputs into the plant.

Better concentration statistics are available on livestock through the Packers and Stockyards Annual Report. Statistics for 2012 indicate steer and heifer slaughter had a CR4 of 85, cow and bull slaughter a CR4 of 56, hog slaughter a CR4 of 64, and sheep and lamb slaughter a CR4 of 62.[5] In three of the four cases, the CR4 was higher than the composite CR4 of 60.7 reported for NAICS 311611 in Table 1. The national Packers and Stockyards statistics do nothing, however, to address the issue that relevant procurement markets for livestock are likely less than national in geographic scope.

Concentration in food retail is another area of concern. The supermarket revolution has taken place in waves—first in the United States, with major consolidation and structural change through mergers, acquisitions, and internal growth in the mid-to-late 1990s (Elitzak), next in Western Europe, and then spreading quickly across the world including Central and Eastern Europe (Dries, Reardon, and Swinnen), Latin America (Reardon and Berdegué), Central America (Berdegué

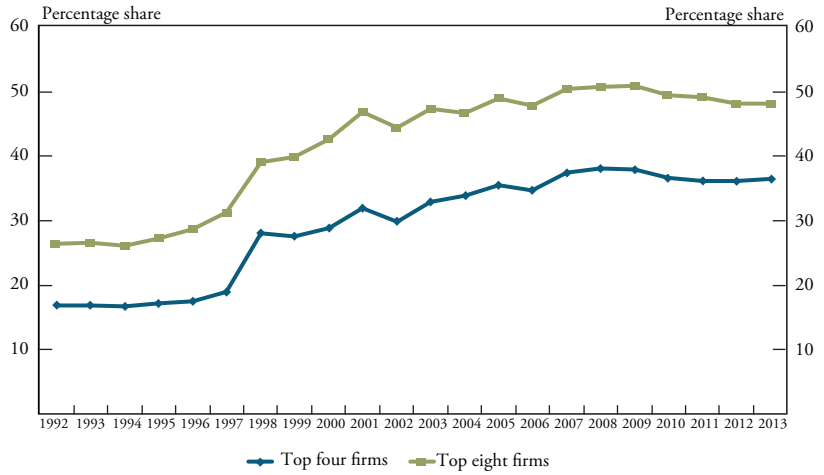
and others), Africa (Reardon and others), and Asia (Reardon, Timmer, and Berdegué; Hu and others). These profound changes in the food-retailing sector have precipitated rapid centralization of procurement systems, an erosion of the role of the traditional wholesaler in favor of direct marketing, increased vertical coordination through contracts with suppliers, and the implementation of private standards to regulate product quality and safety (Dries, Reardon, and Swinnen; Reardon and Timmer) and, increasingly, proscribe farm production practices (Saitone, Sexton, and Sumner). Overall these developments have made large multinational retailers the dominant players in the food chain.

In the United States, sales by the 20 largest food retailers totaled $449.3 billion in 2013, accounting for 63.8 percent of U.S. grocery store sales (Elitzek). Chart 1 depicts the share of grocery sales for the top four and top eight retailers in the United States from 1992 to 2013. While the CR4 for supermarket and supercenter retailers has declined slightly since 2008, the longer-term trend shows increased concentration among the largest grocery retailers, with the CR4 increasing by more than 110 percent from 1992 to 2013. One contributing factor to such increases over the past decade has been the steady growth of Walmart Supercenters. Walmart is the world's largest food retailer despite having only entered food retailing in the mid-1980s. Although its national market share in U.S. food and beverage sales was only 17.3 percent in 2013, it is nearly double the 8.9 percent share of second place Kroger (Statistica).

National statistics on food retailing, although interesting, say nothing about concentration in local markets, which is the relevant geographic dimension when considering food retailers' market power over consumers. Concentration measures for food retailing in localized markets are challenging to come by, given that sales data for grocery retailers are not publicly available. The handful of estimates on local concentration that are available have been compiled by individual researchers. For example, Richards and Pofahl use Nielsen Trade Dimensions data to estimate the CR4 in five cities: Atlanta (81.9 percent), Chicago (60 percent), Dallas (63.7 percent), Los Angeles (59.1 percent), and New York (63.8 percent). The most recent estimate of the U.S. average MSA-level CR4 for food retail is 63 percent for 2014 (Volpe and others).

Chart 1

Concentration of Top Four and Top Eight U.S. Grocery Retailers



Source: USDA-ERS calculations using data from U.S. Census Bureau, Monthly Retail Trade Survey, company annual reports, and indsutry sources.

In a more nuanced analysis, Hoskin, Olson, and Smith analyze how prices are affected in regional markets following grocery retail mergers. Within their sample, eight of the 14 markets where mergers occurred were highly concentrated according to DOJ merger guidelines (HHI > 2,500), while the remaining markets were unconcentrated (HHI < 1,500).[6] Two control groups also had high average degrees of concentration of 3,368 and 2,914. Although these concentration measures are likely to be more accurate than those evaluated at the national level, they are likely still too broad to constitute a relevant geographic market. From a consumer perspective, grocery markets are highly localized, with evidence suggesting that consumers typically travel at most a few miles to shop for groceries.[7]

III. What Are the Key Concerns about Concentration and Market Power in the Food Sector?

In the United States, the pendulum has swung dramatically away from the SCP era and its accompanying concerns about market intermediaries' influence on food costs and consumer welfare. Today, food comprises a low average share of U.S. consumers' disposable incomes, around 11 percent since 2000 (11.4 percent in 2014). Lower shares of

income spent on food at home have been offset by higher shares spent on food away from home. The share spent on food consumed at home is most relevant to discussions of how food costs affect consumers; in 2014, this figure was 6.0 percent.

In addition, the United States, relative to almost any other country, has an abundance of feeding programs intended to support the dietary needs of the poor. In 2016, over 44 million Americans participated in the Supplemental Nutrition Assistance Program (SNAP), with an average monthly benefit of $125.50 and a total program expenditure of $66.6 billion. In addition, the Women, Infants, and Children (WIC) and school lunch programs contribute to the dietary needs of millions. Food costs appear to be a minor consideration among advocates for the poor in the presence of these programs.

An additional consideration in the waning importance of food costs from a consumer's perspective is the emergence of discounters, most notably Walmart, as key players in food retailing. Walmart's rapid emergence as the country's leading food retailer has had three salutary effects on food prices. First, Walmart has set low prices for food as it sought to expand its market share and enter new markets.[8] Second, conventional retailers often charge lower prices when confronted with head-to-head competition from Walmart (Hausman and Leibtag; Volpe and Lavoie). And third, Walmart has ruthlessly driven costs out of the supply chain and forced its rivals to attempt to match its procurement strategies. Beyond introducing efficiencies into food marketing, Walmart and other increasingly powerful food retailers are also likely able to reduce food costs by countervailing the market power of food manufacturers (Calvin and Cook).

In the next decade, online food retailing has the potential to disrupt food retailing and inject new competition similar to Walmart's entry in the 1980s. While generous estimates from the U.S. Dept. of Commerce indicate that online grocery retailing accounted for only 2 percent of total sales in 2015, these national averages fail to reflect online grocery retailers' penetration in specific urban geographic markets or the substantial growth predicted over the next five to 10 years. *Bloomberg Businessweek*, for example, predicts online grocery retailing will be 11 percent of total sales by 2023 (Steinman).

Amazon topped *Supermarket News*'s list of the top 10 digital food retailers with $2.1 billion in sales in 2015 (Springer). But four of the

remaining top 10 digital food retailers were conventional brick-and-mortar stores, including Kroger ($650 million in sales), Walmart ($350 million), Albertsons ($250 million), and Costco ($170 million).[9] The potential of online sellers to enhance competition in food retailing is substantial. Given that online retailers apparently do not calibrate their prices to localized market conditions, brick-and-mortar retailers with market power in local markets are subject to being undercut by online retailers if they attempt to raise prices to capture monopoly profits.[10]

Farm-product markets and buyer power

As interest in food intermediaries' power to raise prices to consumers wanes, the policy focus at both the state and federal level has shifted back to the effects of concentration and market power in food processing and retailing on farmers, with particular emphasis on the procurement arrangements these buyers use and the ability of small farmers to compete and participate in modern supply chains (Saitone and Sexton). On the surface, these concerns are justified. As noted, national concentration rates seldom represent relevant agricultural product procurement markets and thus likely dramatically understate concentration in the local or regional markets relevant for procurement.

Indeed, a common complaint among U.S. farmers is the absence of selling opportunities. Producers often have only one—or at most, a few—willing buyers for their products. This complaint was a recurring theme at the joint USDA-DOJ listening sessions conducted across the United States in 2010. The following comment from a cattle producer is representative:

> 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 an oddity (U.S. DOJ 2010a, p. 211).

The role of contracts and vertical coordination in farm-product procurement

High buyer concentration in local procurement markets, increased vertical coordination and vertical restraints, and the emergence of dedicated supply arrangements, whether codified through formal contracts or not, have combined to generate considerable concern among

some farm groups and policymakers about the buying power of food manufacturers and retailers. The use of contracts in U.S. farm-product markets has expanded rapidly over time, though it appears to have stabilized in recent years. In 1969, only 5 percent of farms engaged in contracting, with those contracts covering roughly 11 percent of the value of production (MacDonald and Korb). In 2013, 35 percent of the production value of all commodities was transacted via contracts (MacDonald 2015). Contracts are the dominant form of exchange in the United States for most livestock, produce commodities, and fruits and nuts. The aggregate percentage share for contracts is depressed due to the importance in the United States of major grains that are the remaining bastions for cash markets.[11]

Contracts in U.S. agriculture differ greatly in their format across industries. Resource-providing contracts introduce substantial buyer decision-making into the farm production process, thereby reducing farmer autonomy. Broiler and hog contracts are key examples: in these contracts, the downstream buyer supplies chicks or piglets, feed, and medication, while the farmer mainly supplies labor and capital in the form of growing houses. In other instances, buyers do not directly provide inputs but dictate what types of inputs can and cannot be used. A key example is the prohibition of antibiotics for growth promotion and disease prevention (Saitone, Sexton, and Sumner). Marketing contracts, on the other hand, may provide little more detail than the price or a basis for setting the price and volume to be exchanged.

One policy concern with expanding contract production and increasing the degree of buyer control written into some contracts are that such contracts lock sellers into a particular buyer, creating in essence a monopsony procurement situation with the potential for opportunistic behavior. A second concern is that small producers will be disadvantaged in terms of securing contracts, perhaps leaving them with no home for their production. These concerns are not without merit.

Generally, livestock production has shifted over time toward large and specialized confinement and feeding operations, which typically use a variety of contractual arrangements (MacDonald and Korb). In 2008, nearly 53 percent of total livestock production was elicited under contract. However, within the livestock sector, these percentages vary substantially. While large cattle-feeding operations are likely to have

production contracts with cattle ranchers and marketing arrangements with meat packers, only 29.4 percent (by value) of cattle production in 2008 took place under a contractual arrangement (MacDonald and Korb). Focusing on steers and heifers, 46 percent of cattle in 2008 were transacted with forward or formula contracts (U.S. Congressional Research Service).

Both the hog and dairy industries have higher contract shares relative to cattle at 68 and 54 percent, respectively. In 2009, only 8 percent of hogs were transacted via spot or cash markets; the rest were sold via forward or formula contract (49 percent), production contract (12 percent), packer/processor owned (26 percent), and packer sold (6 percent) (U.S. Congressional Research Service). Nearly 90 percent of all poultry and egg production in the United States (by value) takes place under contract (MacDonald and Korb). In 2006, 98 percent of the 17,440 broiler farms surveyed had production contracts in place with an integrator (MacDonald 2008).

Broiler producers make substantial investments in growing houses but are then dependent upon a single buyer or "integrator" to supply chicks. These arrangements have resulted in litigation and proposed regulations under the Packers and Stockyards Act to restrain buyer behavior in these settings. Moreover, a number of lawsuits (for example, *John Gross and Company, Inc. v. Koch Foods, Inc. et al.*; *Shelia Adams and James Adams et al. v. Pilgrim's Pride Corporation*) have been filed alleging that an integrator or group of integrators manipulated production to increase processed chicken prices. These lawsuits allege that integrators reduced production by reducing the number of growers' flocks and eliminating grower relationships. In addition, in a recently filed case (*Haff Poultry Inc. et al. v. Tyson Foods Inc. et al.*), contract growers allege that major integrators (for example, Tyson, Pilgrim's Pride, and Perdue Farms) shared confidential production and grower payment records to fix and suppress the prices paid to broiler contract growers while also agreeing to not solicit other integrators' contract growers.

"Lock in" need not involve the physical capital that is typical in these livestock settings. For example, Adjemian, Saitone, and Sexton discuss a case of U.S. malting barley production wherein most brewers have proprietary varieties of barley for their beer production, effectively locking in farmers to a single brewer or maltster because fields must be fallowed to prevent contamination if an alternative variety is to be planted.

Small farmers may indeed be disadvantaged in securing a contract. First, it is in buyers' interest to engage with the most efficient producers. This will increase the total available surplus associated with the transaction, which ultimately will be shared between buyer and producer. Small-scale farmers will seldom be the most efficient, regardless of industry. Second, the transaction costs of executing and enforcing contracts may be high, and executing agreements with a handful of large-scale producers will always be less costly than doing so with many small producers. With justification, the viability of farmers is generally linked to the health of rural America and, more specifically, concerns that trends in U.S. agriculture will result in the depopulation of rural America.

Grain Inspection, Packers, and Stockyard Administration (GIPSA) rules and similar regulations

In 2010, the USDA promulgated regulations that would define an array of commercial practices as violating the Packers and Stockyards Act of 1921 (P&S Act, 7 U.S.C. §181 et seq.). These regulations were written in response to the Food, Conservation, and Energy Act of 2008 (also known as the 2008 farm bill). These so-called "GIPSA rules" (also known as Farmer Fair Practices Rules) were promulgated specifically with the goal of protecting small livestock farmers in markets dominated by contract production. As Edward M. Avalos, Undersecretary for Marketing and Regulatory Programs at the time, stated in congressional testimony, the goal of the regulations was to "improve fairness and transparency in marketing of livestock and poultry . . . What is driving the need to use [USDA-GIPSA's] authority under the Packers and Stockyards Act is our concern about the loss of farmers and the depopulation of rural America" (Hearing).

The original proposed regulations (9 CFR 201) were expansive and detailed. Then-USDA Secretary Vilsack commented on the reach of the regulations, "I think it's fair to say that what we're proposing is aggressive" (Drovers). The critical provisions of the originally proposed regulations fell into four broad categories, and the specific subsections of the proposed regulations along with a brief description are provided in Table 2. The first category of regulations was geared toward eliminating the need to prove actual or potential competitive injury to establish a violation of the P&S Act (§201.2(t), §201.2(u), §201.210(a)). The

Table 2
Summary of Proposed and Finalized GIPSA Rules

Section	Proposed rule	Final rule
§201.3 Applicability of regulations	(a) Poultry: pullets, laying hens, breeder, and broilers; (b) Contracts: swine production contracts, poultry growing arrangements, and livestock production and marketing contracts; (c) Scope: adversely affect or likely to adversely affect competition without being required to show harm or likely harm	Finalized except (c)
§201.94 Record retention	Requires a packer, swine contractor, or live poultry dealer to maintain written records that provide legitimate reasons for differential pricing or any deviation from standard price or contract terms offered to poultry growers, swine production contract growers, or livestock producers.	Not finalized
§201.210 Unfair, unjustly discriminatory and deceptive practices or devices	Provides examples of conduct that would be considered unfair, unjustly discriminatory and deceptive practices.	Not finalized
§201.211 Undue or unreasonable preferences or advantages; undue or unreasonable prejudice or disadvantages	Establishes criteria the Secretary may consider in determining if these actions have occurred under the P&S Act.	Not finalized
§201.212 Livestock purchasing practices	Bans packer-to-packer sales and places restrictions on packer-dealer (buyers), i.e., they cannot represent more than one packer.	Not finalized
§201.213 Livestock and poultry contracts	Requires packers, swine contractors and live poultry dealers to provide GIPSA with a sample copy of unique types of contracts. With the exception of certain information, the contracts may be publicly distributed.	Not finalized
§201.214 Tournament systems	If a poultry dealer is paying growers on a tournament system (where some portion of growers' payments are based on comparisons with other poultry growers' performance), dealers are required to pay the same base pay to those raising the same type/kind of poultry (with no grower paid below the base). Live poultry dealers would be required to rank growers with others with like house types.	Not finalized
§201.215 Suspension of delivery of birds	Establishes criteria to consider when determining whether or not reasonable notice has been given for suspension of delivery of birds to a poultry grower. (a) requires a 90-day notification, (b) requires suspension reason, length, and resumption date, and (c) provides waivers in cases of disasters or emergencies.	Finalized but (a) was rescinded. USDA removed the provision from regulations in February 5, 2015 (80 Federal Register 6430).
§201.216 Capital investment criteria	Establishes criteria to consider whether or not additional capital investments required of a poultry grower or swine producer constitute an unfair practice in violation of the P&S Act.	Finalized. Renamed "Additional capital investments criteria."

Table 2 (continued)

Section	Proposed rule	Final rule
§201.217 Capital investments requirements and prohibitions	Requires a production contract to be of sufficient length to allow poultry or swine growers to recoup 80 percent of investment costs related to the capital investment. Adequate compensation incentives are required for additional equipment investments, if existing equipment is in good working order.	Not finalized
§201.218 Reasonable period of time to remedy a breach of contract	Establishes criteria for determining whether a packer, poultry dealer, or swine contractor has provided a producer a reasonable period of time to correct a breach of contract.	Finalized. Became §201.217 in the final rule.
§201.219 Arbitration	Establishes criteria to consider when determining whether the arbitration process in a contract provides a meaningful and fair opportunity for the poultry grower, livestock producer, or swine contract grower to participate fully in the arbitration process.	Finalized. Became §201.218 in final rule.

Source: Adapted from Greene.

second category was associated with requiring standardization and uniformity of animal procurement to preclude discrimination (§201.210(a)(1)-(7), §201.94(b), §201.211). Regulations in the third category attempted to govern the relationships between packers, producers, and dealers either by specifying permissible contract terms (§201.212, §201.218), mandating that all non-unique contracts be filed and disclosed as samples (§201.213), classifying processor and packer actions as retaliatory, (201.210(a)(2)), stipulating how poultry processors can pay growers when using "tournament"-style pricing (§201.214), requiring 90-days notice of the suspension of live bird delivery (§201.215), or limiting packer/processor influence on producer/grower capital investments (§201.216, §201.217). The fourth and final category included regulations attempting to govern relationships between packers and dealers and precluding the transfer of live animals between packers (§201.212).

Following an extensive comment period wherein 61,000 comments were submitted, the USDA issued a final rule December 9, 2011. The final rule, a significant modification of the proposed rule, included only four provisions: suspension of the delivery of birds, additional capital investments, remedy of breach of contract, and arbitration (see Table 2). However, in November 2011, before the rule was finalized, Congress passed the Consolidated and Further Continuing Appropriations Act, 2012, which prohibited the USDA from finalizing

or implementing the most contentious parts of the rule. Congress continued to enact such appropriations riders in 2013, 2014, and 2015.[12]

However, the Consolidated Appropriations Act of 2016 did not include a rider prohibiting the USDA from finalizing and implementing the rules. The USDA hence published the interim rules on December 20, 2016, and scheduled implementation for February 21, 2017. The rules were again placed in limbo when on January 20, 2017, President Trump signed an executive order freezing pending regulations from the Obama administration.

Both preceding and following the promulgation of the GIPSA regulations, various jurisdictions (federal and state) have written and lobbied for similar legislation. A recent example is Senator Grassley's reintroduction of a bill that would amend the Packers and Stockyard Act to make it unlawful for a packer to own, feed, and control livestock intended for slaughter. Some states, including Nebraska (under the Competitive Livestock Markets Act), prohibit packers from owning cattle and hogs more than five days prior to slaughter.

IV. What Are the Efficiency and Distributional Consequences of Consolidation, Vertical Coordination, and Market Power in the U.S. Food Sector?

As we have shown in the prior sections of this paper, relevant measures of market concentration are elusive given the manner in which such statistics are compiled and reported, as is evidence on the importance of market power in the food chain. A third, less frequently discussed but contentious issue is the consequences of market power when it is present. Economists' traditional thinking about the consequences of buyer or seller market power is based on a simple partial equilibrium microeconomic model that may not be realistic for most modern markets. The standard model prescribes that a firm with market power strategically reduces its sales (seller power) or purchases (buyer power) in recognition that its actions influence price. Thus, quantities get reduced below the socially optimal (specifically, competitive) level, creating a deadweight or efficiency loss also known as the Harbarger triangle. However, the magnitude of these triangles is very small relative to the market's total surplus for moderate levels of market power of the

magnitude found in most empirical studies of specific food industries (Alston, Sexton, and Zhang; Sexton 2000).[13]

A second point is that these deadweight or efficiency losses emerge only because firms with market power are presumed to be constrained to charge or pay a simple linear (nondiscriminatory) price to all customers or suppliers. Such pricing schemes reflect traditional spot or cash markets that are in decline or nonexistent in many of today's agricultural markets and becoming rarer in retail markets. Deadweight losses represent "money left on the table" that a firm with market-power access to multiple pricing instruments can reduce or eliminate. Examples of multipart pricing at retail are membership fees, price discounts associated with club or loyalty cards, and even strategic use of sales, coupons and pricing for similar products with perceived heterogeneous qualities such as store versus national brands. These are all examples of what economists call *price discrimination*. The multitude of information on consumers that retailers now gather and analyze—and improved technologies for tailoring prices to specific customer segments—facilitate such practices. Retailers extract more surplus from consumers, but they also diminish any deadweight or efficiency losses associated with market power.

In agricultural product procurement markets, contracts often specify both prices and quantities and also contain provisions for price premiums or discounts for a variety of factors. Contracts may also tailor individualized prices to specific producers. Such devices attenuate the traditional link between price paid and quantity received.

Given evidence that market power in agriculture is modest at best—and the various mechanisms available to firms to obviate deadweight or efficiency losses—the inescapable conclusion is that efficiency losses in the United States due to agricultural market intermediaries' market power are inconsequential and of no policy relevance.

Implications for distribution of welfare

What remains, then, are concerns about market power's implications for the distribution of welfare across farmers, intermediaries, and consumers in the food chain. The distributional consequences of market power exercised by market intermediaries can indeed be much greater than the pure efficiency consequences and, in some cases, may provide a legitimate basis for policy concern. Even modest seller or

buyer power that reduces farm-product purchases and final outputs can transfer significant shares of market surplus from farmers and consumers to intermediaries' profits relative to the benchmark competitive equilibrium. A corollary to this point is that market intermediaries with even modest amounts of market power can capture large shares of the benefits from policies intended to benefit farmers, such as price supports or reductions in tariff barriers (Russo, Goodhue, and Sexton; Sexton and others).

To illustrate these points, we parameterize a prototypical agricultural product market with linear farm supply and consumer demand curves where farm value is 50 percent of retail value at a competitive equilibrium. Our example assumes the absolute values of the price elasticities of consumer demand and farm supply are each 0.5 at the competitive equilibrium, reflecting the stylized fact that both farm supplies and consumer demands for food tend to be price inelastic.

We introduce both buyer and seller market power into this market using standard methods, as discussed, for example, in Sexton and Lavoie. Without any loss of generality, the extent of market power can be parameterized on the interval [0, 1], with 0 denoting perfect competition, 1 denoting pure monopoly or monopsony, and intermediate values representing oligopoly and oligopsony, with increasing values representing increasingly severe market power. Most empirical studies of market power in the food sector have found values of buyer and seller power to be in the range of 0.2 or less.

We can freely choose units to measure money and output, and thus set the consumer price under perfect competition to be $P^C = 1.0$ and both the farm-product and final-product output to be $Q^C = 1.0$. Given our assumption about farm share, the farm price in perfect competition is $W^C = 0.5$. Under perfect competition, the total economic surplus in our hypothetical market is 1.50, with farmers getting one-third (0.50) and consumers getting two-thirds (1.00). The competitive marketing sector earns zero economic profits in this example. The absolute levels of surplus and the share distribution across farmers, consumers, and marketers is a function of the underlying structure of the example and of no particular importance. What is important is to see relative changes as we introduce market power.

Suppose we set intermediaries' power as both buyers and sellers to 0.2. Although this value represents modest market power, it is still at the upper end of what most empirical studies have found. This market power causes retail prices to rise to $P^0 = \$1.33$, farm prices to fall to $W^0 = \$0.33$, and the quantity produced and sold to decline to $Q^0 = 0.83$. The deadweight or efficiency loss created by this market power is only 2.8 percent of the total economic surplus at the competitive equilibrium, but consumers' and farmers' welfare both decline by more than 30 percent relative to the competitive outcome; the market intermediaries capture more than 31 percent of the available surplus. Although this specific outcome is a function of the parameters chosen for the example, it nonetheless illustrates that even modest market power can have a significant effect on the distribution of welfare. This is an important observation for policy purposes, as much of farm policy is geared toward the welfare of farmers, especially smaller farmers.

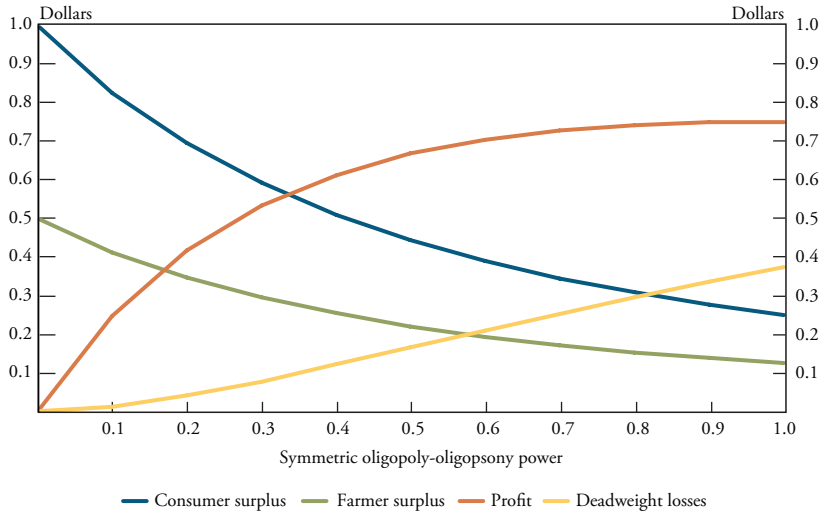
Chart 2 extends this example by plotting consumer surplus, farmer surplus, marketing sector profits, and efficiency losses over the full range of possible values for market power. Notably, it doesn't take much intermediary market power for intermediaries' share of the market surplus to farmers' or consumers' shares. Deadweight or efficiency losses increase at an increasing rate as a function of intermediary market power; however, as noted, no evidence currently supports such high levels of market power in the United States. Furthermore, this example is for a spot market with simple linear prices, so real-world pricing devices that might reduce deadweight losses are absent.

Implications for the efficiency of American agriculture

We believe that any discussions of efficiency and productivity in U.S. or world agriculture should be conducted in the context of the challenges facing world agriculture moving forward. The United Nation's Food and Agriculture Organization (FAO) projects global food demand to grow by 70 percent from 2005 to 2050 (Alexandratos and Bruinsma). Other analysts (for example, Tilman and others; Ray and others) predict even greater growth in demand in the range of 100–110 percent over the same period.

Regardless of the specific demand-growth estimate, most researchers agree that increased agricultural productivity is the key to global food

Chart 2
Effects of Symmetric Oligopoly-Oligopsony Power



security in the future (Tilman and others; Leifeld). However, growth in crop yields has slowed over the past two decades, with global yield growth for key grains and oilseeds, maize, rice, wheat, and soybeans slowing substantially from 1990 to 2007 compared with the prior 30 years (Alston, Beddow, and Pardy; Grassini and others).

Productivity is also critical to the environmental consequences of food production. This debate centers on the environmental effects of intensive versus extensive expansion of agricultural production to meet global food needs. Given that the leading cause of anthropogenic greenhouse gas emissions is converting land to agriculture, strategically intensifying existing agricultural lands to increase production will lead to greater reductions in greenhouse gas emissions and nitrogen fertilizer use than clearing more land to expand food production (Tilman and others).

As an earlier quote from the U.S. GAO illustrates, considerable evidence supports the efficiency benefits of consolidation in the food chain. Although evidence for the efficiency benefits of vertical coordination is less extensive, it also creates a clear picture. Vertical coordination between producers and downstream buyers enhances efficiency for both buyer and seller. Advantages for the buyer include the ability to operate processing facilities at efficient capacities by securing

necessary supplies of the farm product through contracts or vertical integration, with the characteristics and timing needed to operate highly capital-intensive plants efficiently.[14] The GAO makes this point as well in describing hog processing:

> 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.

Efficiency gains to farm production from vertical coordination and contracting also appear likely, though the evidence for these is more scant. Key and McBride provide one key example about implementing contract production for hogs. The rapid adoption of resource-providing contracts in hog production in the 1990s provided an unusual natural opportunity to compare the efficiency of contract versus independent production systems. Key and McBride found the contract production system yielded efficiency gains of 20 percent due to improved factor productivity attributed primarily to the transfer of knowledge from processors to producers.

Consequently, regulations such as the GIPSA rules and, indeed, any restrictions on contracting and vertical coordination practices must be evaluated in light of their implications for economic efficiency. If the primary motivation for regulating or proscribing various marketing arrangements is to enhance efficiency by enabling plants to operate at efficient capacity, improve information flows, and reduce the transaction costs of marketing, then regulations that impede these objectives will—under the ordinary transmission of cost and price changes through the marketing channel back to the farm or ranch and forward to consumers—reduce farm prices and producer welfare on net and cause higher consumer prices and reduced consumer welfare. To offer just one example, Brester and Marsh find that technological changes in meatpacking contributed to proportionately greater reductions in marketing margins and increases in real hog prices over time—specifically, they estimate a 1 percent increase in meatpacker productivity reduced the pork farm-wholesale margin by 1.43 percent.

V. Farmer-Buyer Relationships in Modern Agricultural Markets

Given concerns expressed in the United States and elsewhere, the buyer power of food-market intermediaries has been a key research focus for us in recent years, often in conjunction with colleagues (Crespi, Saitone, and Sexton; Sexton 2013; Adjemian, Saitone, and Sexton; and Mérel and Sexton). Our argument, which we develop briefly here, is that the standard economic theories of buyer power and its treatment for antitrust purposes—as, for example, practiced by the DOJ and FTC—may in many cases be fundamentally incorrect. Moreover, under certain conditions that we make explicit, buyer concentration and close vertical coordination between buyers and sellers can unambiguously be in farmers' best interests and improve overall economic welfare.

The standard antitrust treatment is to regard buyer power as basically symmetric to seller power. In other words, input purchasers with power to influence the input's price will respond by strategically reducing purchases to reduce the input's price, thereby increasing the buyer's profits. This reasoning is codified into the merger guidelines issued jointly by the DOJ and FTC. Following a lengthy discourse on mergers among sellers, the guidelines dispatch mergers among competing buyers (section 12) in just 395 words, noting "the Agencies employ essentially the framework . . . for evaluating whether a merger is likely to enhance market power on the selling side of the market."

Our fundamental argument is that there is a short-run versus long-run trade-off regarding the exercise of buyer power that is normally not present regarding seller power. By definition, the exercise of buyer market power depresses an input's price below its value of marginal product—specifically, below the competitive return. It is axiomatic that resources that earn a return below the competitive rate exit the industry in the long run. As we have noted, modern food processing and distribution are highly capital intensive, and it is imperative for plants to operate at efficient capacity. A buyer who depresses prices to its farm suppliers by exercising its market power thus risks causing its suppliers to exit the market and deterring other suppliers from entering it, undermining the buyer's ability over time to source the farm products it needs to operate efficiently and meet its downstream selling obligations.

As a result, buyers operating in a given procurement area who value the future have a mutual incentive to pay suppliers a sufficient return to remunerate their capital investments—that is, at least what economists term a "normal" return on investment—so as to preserve the "stock" of suppliers into the future. The problem is that in the oligopsony procurement environment typical of many modern agricultural markets, each buyer internalizes this incentive only to the extent that it affects the buyer's own future profits. Effects on other buyers operating in the same market are an externality and not considered. The situation is closely analogous to a tragedy of the commons: here, the common or shared resource is not a grazing range or a fishery, but rather a collection of farmers producing an agricultural product required for the buyers' operations.

This means that the market environments most conducive to the exercise of buyer market power are loose oligopsonies operating in spot markets where individual buyers have power to influence the farm price but are unable to internalize a substantial share of the benefits from paying a price sufficient to sustain or expand the stock of production. Similarly dangerous are settings in which buyers highly discount the future—for example, due to severe financial stress or operating in a declining industry—and are thus motivated to increase short-run profits by exercising their buyer power.

In contrast, in environments in which buyers highly value the future and can internalize much of the benefits of supporting the viability of their suppliers, buyers have incentive to pay farm prices sufficient to enable farmers to earn at least normal returns on their capital investments to preserve this stock of suppliers into the future. Students of economic theory will recognize that this outcome is analogous to the long-run equilibrium in a competitive industry, wherein all active participants earn normal returns on their investments. It is important to recognize, however, that the market process at work here is fundamentally different from the tatonnement process of entry and exit that brings a competitive industry to this equilibrium. Here, the outcome is due to buyers rationally paying a return high enough to preserve their stock of suppliers into the future. Farmers earn a satisfactory return on their investments even though they may have few or only one selling option.

It is both ironic and unfortunate, then, that public policies and regulations that are either in place or actively being pursued, such as the

GIPSA regulations, may prevent these types of symbiotic relationships between buyers and sellers and thus operate at cross purposes from what their proponents seek to achieve. In terms of merger policy, the DOJ is most likely to challenge mergers that cause markets to go from loose oligopsonies to tight oligopsonies or monopsony. But as Mérel and Sexton demonstrate analytically—and illustrate using recent antitrust actions by the DOJ—such mergers enable buyers to more fully internalize the benefits from paying returns necessary to preserve the stock of suppliers in the long run. Thus, preventing such mergers preserves the "tragedy of the commons" effect and may well be detrimental to farmer welfare.

The GIPSA regulations and related policies are designed to proscribe contracting practices, specifically for livestock, to create a "level playing field," especially for small farmers, such that any producer has an opportunity to obtain a contract. However, by restricting the types of contract arrangements that can be executed between a buyer and sellers or by requiring in effect an "open market" for contracts, such regulations impede the emergence of the symbiotic relationships essential to guaranteeing producers prices that enable a competitive return on investment.

VI. Conclusion

We survey the latest evidence on concentration and consolidation in the food processing and distribution and retailing sectors. We find the pace of consolidation appears to have stabilized in recent years, but because the publicly available data often do not conform to relevant product or geographic markets, it is not easy to distill implications for market power and policy from such data.

Our view is that on balance, consolidation of food marketing has benefited consumers. Food costs are a small and stable share of budgets for most Americans, with increased spending on food consumed away from home preventing what otherwise would be a declining food budget share. Consumers also have a remarkable array of choices, due at least in part to the size of modern groceries and their global procurement strategies. We conclude that food costs are no longer a major policy concern—indeed, today's food consumers are practically

encouraged to pay more for food intended to contribute to an array of social and environmental goals.

The policy focus instead has shifted to farm-product procurement markets and intermediaries' power as buyers. Unquestionably, many U.S. farmers have few (and perhaps only one) sales outlets today, which justly triggers some alarm bells—as does the increasing vertical control, manifested mainly through contracts, that has swept through procurement markets for many commodities. We show that these developments unquestionably enhance efficiency, a point that should not be disregarded as we face the challenge of feeding a rapidly rising world population during a time of rather stagnant agricultural productivity growth.

We set forth a model for agricultural product procurement markets that we have developed in detail in a series of recent journal papers. This work runs counter in its predictions and policy implications to the standard paradigm that equates concentration with market power and efficiency losses. Farmers can fare very well in modern procurement markets if conditions are right for them to establish a symbiotic relationship with a downstream supplier. However, we discuss various policies and regulations in place or being contemplated that are likely to interfere with forming such arrangements. This is an ironic outcome, given that the proponents of such policies intend for them to benefit farmers, especially small farmers. Our framework also provides a basis for predicting market settings when buyer power concerns are most pronounced, namely when symbiotic relationships are unlikely to emerge because of high discount rates or buyers' inability to internalize the benefits of forging such relationships with suppliers.

Small farmers have a difficult role in modern agricultural supply chains. An abundance of small farmers no doubt contributes to populating and preserving the vitality of rural America, but small farms are likely to be inefficient in multiple dimensions compared with larger operations, and the supply chain ruthlessly seeks out the most efficient operators. Policies intended to promote small farms mostly do so by trying to curtail efficiency-enhancing marketing arrangements. We do not think such policies are wise in light of the challenges facing global agriculture. Better policies with spillover benefits for rural America would support small farmers directly without disrupting market forces that enhance efficiency.

Endnotes

[1]SCP theorists believed that product differentiation and expenditures to promote it were wasteful and an artifact of the power of food manufacturers. Today, some 30 or more years later, most view variety and differentiated products as something consumers value.

[2]Another problem is that the NAICS system replaced the Standard Industrial Classification (SIC) system that was the basis, for example, of Rogers and Sexton's (1994) work, making direct comparisons across longer periods difficult.

[3]CR4 is the sum of the market shares of the largest four firms in the industry. HHI is the sum of every firm's squared percentage share of market value in the industry. HHI measures give proportionally greater weights to firms with larger market shares relative to CR4 and incorporates information beyond the four largest firms.

[4]Typically, industries that are classified as unconcentrated are not subject to DOJ scrutiny. However, in industries classified as moderately concentrated, mergers that would increase the HHI by 100 points or more raise competition concerns and are often evaluated (DOJ 2010b).

[5]HHI statistics are not included in the report.

[6]The sample of markets was very heterogeneous, encompassing both medium-sized U.S. markets and substantial markets (for example, New York, Philadelphia, and Detroit).

[7]For example, a nationally representative survey of SNAP-eligible consumers by Ohls and others found that among program participants, the average distance to the nearest supermarket was 1.8 miles, but the average distance to the store used most often by participants and eligible nonparticipants was 4.9 miles. It should be noted that shopping patterns and access to transportation may differ for SNAP participants relative to the general populations. Our own work for WIC recipients in the greater Los Angeles area (Wu, Saitone, and Sexton) shows average travel distances of 3.2 miles for participants living outside of food-desert areas and 3.59 miles for food-desert residents.

[8]Even though Walmart has accomplished substantial share growth in becoming the largest food retailer in the United States, its cost-cutting continues apace. Its current pricing strategies are believed to be designed to ward off competition from Amazon and European discount grocery retailer Aldi (PYMNTS).

[9]Given that two-thirds of the population in the United States lives within 5.3 miles of a Walmart store, online retailing has the potential to extend Walmart's reach and low prices beyond simply the local markets where it has brick-and-mortar stores (Perez).

[10]Although little is known about how food retailers set prices geographically, large retailers appear to use pricing zones, which often coincide with a metropolitan area. Thus, prices for a chain are normally the same across a metropolitan

area. This, of course, means that localized pockets of monopoly power due to high concentration would not be exploited. Similarly, evidence suggests brick-and-mortar retailers generally have the same prices in store as online, although there may be a delivery charge.

[11]MacDonald and colleagues at the USDA periodically update information on contract production in U.S. agriculture. Small year-to-year fluctuations in the percentages are mainly due to changes in the value of production for cash-market grains relative to the other commodities for which contracting dominates.

[12]The 2013 and 2015 appropriations acts included language to rescind three provisions that the USDA had finalized in 2011. These were a definition of the "suspension of delivery of birds," a 90-day notification period required when a poultry company suspends the delivery of birds to a grower, and a provision that made the rule applicable to live poultry. In February 2015, the USDA removed these three provisions from the regulations.

[13]The triangle increases at an increasing rate as a function of the degree of market power exercised, so if market power is severe or is exercised at multiple stages along the market chain, deadweight losses become large and consequential (Sexton and others). There is no evidence to support such occurrences for food in the United States.

[14]A point worth emphasizing is that for these same reasons, a processor's demand for farm products is very inelastic in the range of its plant capacity. Once a firm has secured a supply sufficient to operate at efficient capacity, additional farm product is of little value. This point is relevant to the recurring theme from the joint USDA-DOJ listening sessions in 2010 that farmers had few selling opportunities. In modern agricultural markets, buyers are unlikely to be interested in sourcing additional product once they have supply commitments in place.

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Financing a Changing Agricultural and Rural Landscape

By Allen M. Featherstone

The agricultural economy is in a constant state of adjustment, having undergone several major adjustments over the last 40 years ranging from the farm financial crisis of the early 1980s—a relatively long period of stability and low to moderate levels of profitability—to a period of high profitability from 2007 through 2014, to a recent period of low profitability with average net farm income for some Midwestern states close to or below zero.

During this period, the number of farms in the United States has declined and average farm size has steadily increased.

Similar consolidation has occurred in the agricultural lending industry; specifically, with commercial banks and in the Farm Credit System. Wheelock and Wilson (2012) state that from 1984 to 2008, the number of commercial banks fell from 14,482 to 7,086. In addition, the number of Farm Credit Associations decreased from 304 in 1990 to 77 in 2017 (U.S. Department of Agriculture Economic Research Service; Farm Credit Administration). The decrease in the number of farms has also coincided with consolidation of the firms that provide inputs to or purchase outputs from farmers (Saitone and Sexton). Langemeier and Boehlje discuss the drivers of consolidation occurring in production agriculture and the agribusiness industry.

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As the farming sector has consolidated, the agricultural lending situation has also changed. Brewer and others illustrate that the average number of lender relationships for Kansas farms increased from 1.8 in 2002 to 2.0 in 2010, and the number of loans per farm increased from 3.1 to 3.4 over the same period. While they report that single-institution relationships are still most common, with 49.6 percent of Kansas farmers working with one lender, 48.3 percent of Kansas farmers have from two to four lender relationships, with the remaining 2.1 percent having more than four relationships.

Just as economies of scale are often cited as a reason for consolidation in production agriculture, economies of scale have also been argued as a reason for consolidation in the banking literature. Using Call Report data from 1990, Featherstone and Moss estimate that multiproduct economies of scale for agricultural and rural banks was very near constant returns to scale. Research on banking in the 1980s found that scale economies exist up until about $100 million in assets, while research in the 1990s found that scale economies are exhausted at about $10 billion in assets (Mester).

Wheelock and Wilson (2012), using a nonparametric method for estimation and data through 2006, find that most U.S. banks face increasing returns to scale. They attribute that to increased off-balance-sheet bank activity. Wheelock and Wilson (2017) also examine economies of size in U.S. banking using a cost-function approach with data through the fourth quarter of 2015. They again find that a large majority of banks face either constant returns to scale or increasing returns to scale. They conclude that their results "are thus similar to other recent studies finding that even many large banks operate under increasing returns to scale."

Thus, the implication is that consolidation will continue in the banking sector. Given the continued consolidation in the production agriculture sector and the economies of scale of the commercial banking industry reported by Wheelock and Wilson (2017), the delivery of credit will continue to change into the future. In this article, I examine the heterogeneity of consolidation across states for both production agriculture and the agricultural financial services industry along with future growth opportunities in agricultural and rural lending.

A discussion of the agricultural economy within the states that make up the Tenth Federal Reserve District reveals differences among states. Information regarding trends in agricultural banking in the states within the Tenth District also reveals differences. The future of agricultural lending will depend upon how agricultural lenders adapt to new opportunities, factors that underlie future consolidation in the agricultural lending arena, and how communities and businesses need to position themselves to be vibrant into the future.

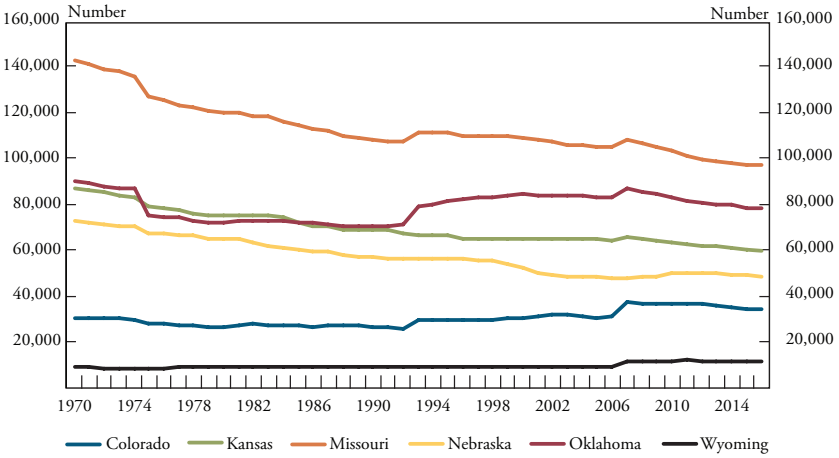
I. Production Agriculture

The Tenth District of the Federal Reserve System comprises a diversity of agriculture, ranging from corn and soybean production similar to the Corn Belt to large expanses of land devoted to the grazing of livestock.[1] Much of the subsurface irrigated acreage in the United States underlies the land base of the Tenth District, which itself will affect the future of agriculture due to the declining water levels of the Ogallala acquifer. In addition, the location of population centers differs widely within the District: some states have major population centers on their borders, while others have population centers that are more geographically centered. Given these differences, it is unlikely for aggregate changes in agriculture to occur in lock step across states within the District.

I obtain farm numbers in Colorado, Kansas, Missouri, Nebraska, Oklahoma, and Wyoming since 1970 from the USDA National Agricultural Statistics Service (NASS) (Chart 1). Since 1970, the number of farms has decreased in Kansas (31.5 percent), Missouri (32.3 percent), Nebraska (33.7 percent), and Oklahoma (13.2 percent), but increased in Colorado (10.8 percent) and Wyoming (33.3 percent). Thus, very different trends have occurred through the Tenth District. Since 1990, after the farm crisis of the 1980s had passed, the number of farms in Kansas, Missouri, and Nebraska continued to decrease by 13.6 percent, 10.4 percent, and 15.1 percent, respectively, while the number of farms in Colorado, Oklahoma, and Wyoming increased by 27.6 percent, 11.6 percent, and 30.3 percent. States that are large producers of feed grains and oilseeds appear to have seen more consolidation than states with more diversified farms.

Chart 1

Number of Farms

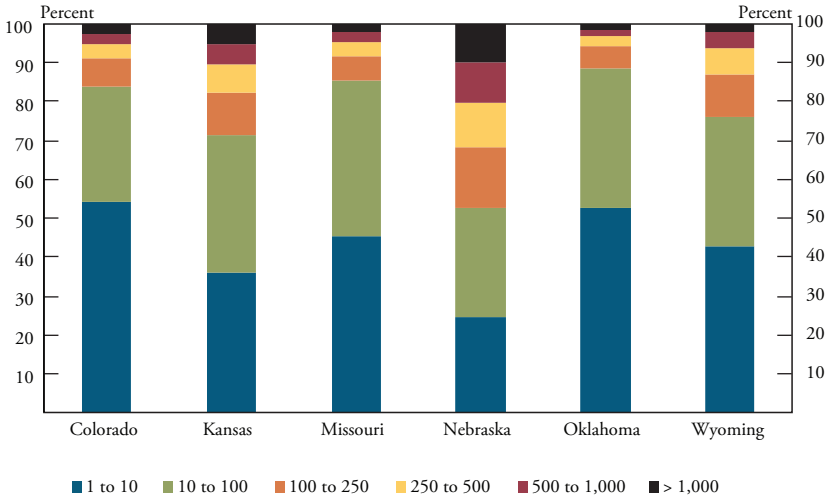


Source: USDA-NASS.

Given the diverse trends in farm numbers, it is instructive to examine both the current distribution of farm size and also changes in farm size over time. The USDA NASS uses annual sales to classify farm size into the $1,000 to $10,000 annual sales category, $10,000 to $100,000 category, $100,000 to $250,000 category, $250,000 to $500,000 category, $500,000 to $1,000,000 category, and greater than $1,000,000 category. Chart 2 shows a stacked bar graph of the distribution of farms within each state by size. In Colorado, Missouri, and Oklahoma, 83.7 percent, 85.4 percent, and 88.5 percent of farms, respectively, had 2016 annual sales of less than $100,000. In Kansas, Nebraska, and Wyoming, 71.6 percent, 52.7 percent, and 75.9 percent of farms had sales less than $100,000. Farms in Kansas and Nebraska were notably larger than farms in other states: 10.4 percent and 19.9 percent of farms, respectively, had annual sales in 2016 greater than $500,000.

Given the change in the number of farm operations within the Tenth District, it is likely that the distribution of farm size has changed over time. Table 1 lists the distribution of farm size in 2000, 2005, 2010, and 2015 for Colorado, Kansas, Missouri, Nebraska, and Oklahoma using the sales categories of $1,000 to $10,000, $10,000 to $100,000, $100,000 to $250,000, $250,000 to $500,000, and greater than $500,000.[2] During the last 15 years, the number of farms with greater than $500,000

Chart 2
Percent of Farms by 2016 Sales Class



Note: Sales class in thousands of dollars.
Source: USDA-NASS.

in sales increased by 1.6 percent in Colorado, 7.2 percent in Kansas, 2.7 percent in Missouri, 14.5 percent in Nebraska, and 1.9 percent in Oklahoma. The number of farms with less than $100,000 in sales decreased by 1.3 percent in Colorado, 8.0 percent in Kansas, 5.6 percent in Missouri, 22.2 percent in Nebraska, and 4.0 percent in Oklahoma. Changing farm numbers and size have not been consistent across states. Kansas and Nebraska have experienced an increase in large farms and a decrease in smaller farms. But Colorado, Missouri, and Oklahoma have not experienced similar increases in large farms.

Given the differences in the distribution of farm size across states, it is important to examine differences in the demand for credit by farms in different size categories. The USDA Agricultural Resource Management Survey (ARMS) reports debt use for Kansas, Missouri, and Nebraska within the Tenth District. The calculated debt-to-asset ratio (total liabilities divided by total assets) differs by farm size in Kansas, Missouri, and Nebraska (Table 2).[3] Generally, the larger the farm size, the higher the debt-to-asset ratio, indicating that larger farms use debt more intensively than smaller farms. In addition, the use of debt by farms differs by state and over time. Due to the rapid increase in land values from 2005 to 2015, the debt-to-asset ratio has generally decreased.

Table 1

Percent of Farms by Sales Class and State

Sales class (in thousands)	Colorado (percent)	Kansas (percent)	Missouri (percent)	Nebraska (percent)	Oklahoma (percent)
			2000		
$1 to $10	51.3	38.8	55.6	26.0	62.1
$10 to $100	33.3	41.2	34.9	40.4	30.5
$100 to $250	8.0	11.9	5.7	19.6	4.3
$250 to $500	3.7	5.0	2.3	8.7	1.9
Greater than $500	3.7	3.1	1.6	5.4	1.2
			2005		
$1 to $10	56.1	43.4	55.1	26.0	61.4
$10 to $100	30.5	38.4	34.4	36.9	30.4
$100 to $250	6.9	10.4	6.1	18.5	4.7
$250 to $500	3.0	4.5	2.6	10.2	1.9
Greater than $500	3.6	3.3	1.8	8.3	1.6
			2010		
$1 to $10	55.1	40.7	53.0	27.3	56.4
$10 to $100	29.8	35.0	35.3	28.9	33.7
$100 to $250	6.7	10.6	5.5	17.0	4.8
$250 to $500	3.6	6.7	2.9	12.1	2.5
Greater than $500	4.8	7.0	3.3	14.7	2.6
			2015		
$1 to $10	54.1	36.4	45.5	25.7	52.7
$10 to $100	29.2	35.6	39.4	28.5	35.9
$100 to $250	7.6	10.8	7.6	15.0	5.7
$250 to $500	3.8	7.0	3.1	10.9	2.6
Greater than $500	5.3	10.3	4.3	19.9	3.1

Source: USDA-NASS.

Table 2
Debt-to-Asset Ratio by Sales Class, Percent

Sales class (in thousands)	Kansas (percent)	Missouri (percent)	Nebraska (percent)
	2015		
$1 to $100	3.9	6.5	6.4
$100 to $250	12.0	8.2	9.9
$250 to $500	7.8	21.0	12.4
$500 to $1,000	9.5	14.2	14.9
Greater than $1,000	22.7	16.0	14.5
	2010		
$1 to $100	7.5	5.3	5.2
$100 to $250	9.9	6.0	8.7
$250 to $500	11.9	9.4	9.6
$500 to $1,000	13.5	9.4	10.8
Greater than $1,000	19.0	17.6	21.3
	2005		
$1 to $100	9.1	7.0	7.7
$100 to $250	12.2	11.6	14.4
$250 to $500	15.5	10.0	16.3
$500 to $1,000	19.6	10.9	19.6
Greater than $1,000	29.8	10.9	32.3

Source: USDA-NASS.

The average level of total liabilities by sales class differs by state (Table 3). Generally, Missouri has a smaller amount of total liabilities for the $500,000 to $1,000,000 and the greater than $1,000,000 sales classes than Kansas or Nebraska. In addition, the amount of total liabilities per annual sales does not increase linearly as the farms grow larger.

II. Commercial Banks

As with production agriculture in the Tenth District, the commercial banking sector has also differed over time. Chart 3 reports the number of banks by state since 1934 (FDIC). The 2015 data indicate that Colorado, Kansas, Missouri, Nebraska, Oklahoma, and Wyoming had 82, 260, 279, 181, 209, and 30 commercial banks, respectively. From 2000 to 2015, the number of commercial banks decreased in all states. Colorado saw the largest decrease in the number of banks (54.7 percent), and Missouri saw the smallest decrease (22.9 percent). While

Table 3

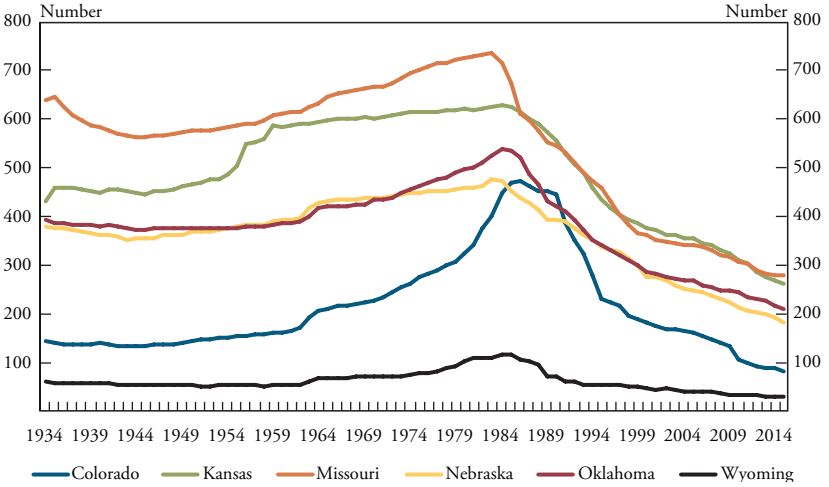
Total Liabilities by Sales Class, Current Dollars

Sales class (in thousands)	Kansas (U.S. dollars)	Missouri (U.S. dollars)	Nebraska (U.S. dollars)
	2015		
$1 to $100	27,284	42,346	55,063
$100 to $250	185,380	147,838	187,664
$250 to $500	253,858	500,071	399,452
$500 to $1,000	420,812	513,797	558,165
Greater than $1,000	1,657,371	802,650	1,112,490
	2010		
$1 to $100	38,684	26,820	38,212
$100 to $250	150,833	93,053	111,657
$250 to $500	234,148	203,531	237,825
$500 to $1,000	330,042	230,165	350,393
Greater than $1,000	1,253,656	716,820	1,207,895
	2005		
$1 to $100	29,171	32,177	36,219
$100 to $250	129,728	153,663	135,484
$250 to $500	225,247	184,630	231,821
$500 to $1,000	484,788	272,917	414,134
Greater than $1,000	1,258,653	679,309	1,654,689

Source: USDA-NASS.

Chart 3

Number of Banks



Source: FDIC.

the number of banks has decreased, the state aggregate volume of loans made to agriculture has increased. I report two classifications of agricultural loans made by commercial banks: those that finance agricultural production and those that are secured by agricultural real estate.

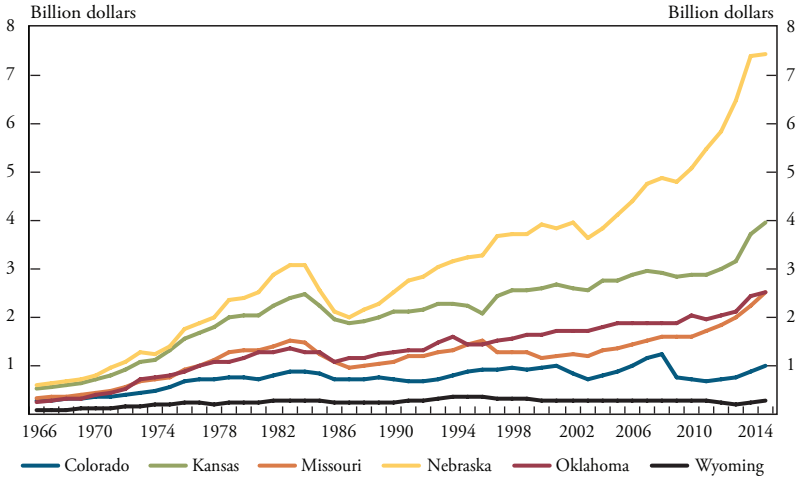
Agricultural production loans finance farms' year-to-year operations. From 1966 to 2015, the aggregate value of agricultural production loans by state generally increased (Chart 4). The major exception was from 1982 to 1987, during the agricultural financial crisis, when the value decreased in Colorado (13.9 percent), Missouri (15.3 percent), Kansas (31.0 percent), Nebraska (30.1 percent), Oklahoma (10.0 percent), and Wyoming (12.3 percent). The aggregate state value decreased much more in Kansas and Nebraska than the other states. From 2000 to 2015, the value of loans increased in Colorado (2.4 percent), Kansas (51.9 percent), Missouri (116.6 percent), Nebraska (91.2 percent), and Oklahoma (54.8 percent). The value of production agricultural loans fell by 5.3 percent in Wyoming. Thus, while the number of commercial banks has fallen, the aggregate value of loans that finances agricultural production has increased.

In addition to agricultural production loans, banks also finance farm real estate. The development of Farmer Mac has facilitated some of this lending. Chart 5 illustrates the aggregate value of farm real estate loans by state from 1966 to 2015. Farmland loans in Missouri did not surpass $1 billion until 1990, while production loans reached $1 billion much earlier. From 2000 to 2015, the value of agricultural real estate loans increased in Colorado (179.1 percent), Kansas (148.6 percent), Missouri (199.8 percent), Nebraska (187.0 percent), Oklahoma (46.1 percent), and Wyoming (76.8 percent). The aggregate state value of loans to finance agricultural land has doubled in each state except Oklahoma and Wyoming since 2000. Thus, while the number of institutions has fallen, the value of loans financing farm real estate has increased. The increase in financing of farm real estate by commercial banks from 2000 is much greater than for agricultural production.

Farm real estate lending has increased in relative importance in commercial bank agricultural lending since 2000 (Chart 6). In 2015, lending for agricultural real estate was nearly 50 percent in Colorado, Kansas, Oklahoma, and Wyoming; 39.1 percent in Nebraska; and 66.5 percent in Missouri. In 2000, however, lending for agricultural real estate was between 29 percent and 36 percent for all states except

Chart 4

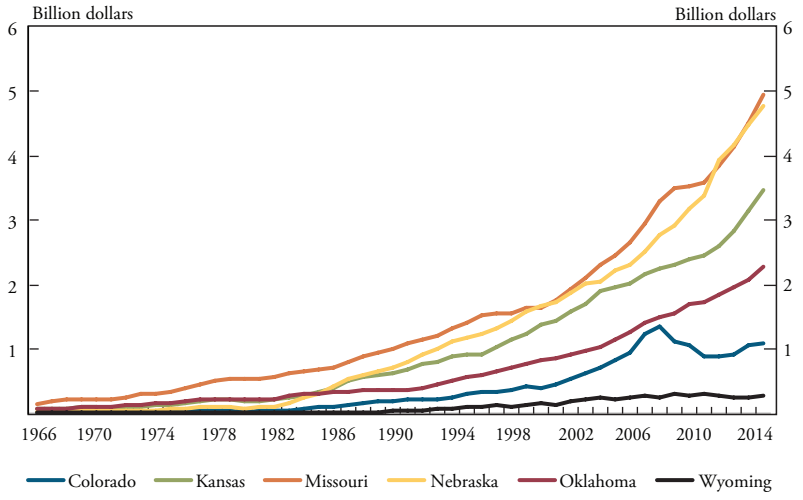
Agricultural Production Loan Values



Source: FDIC.

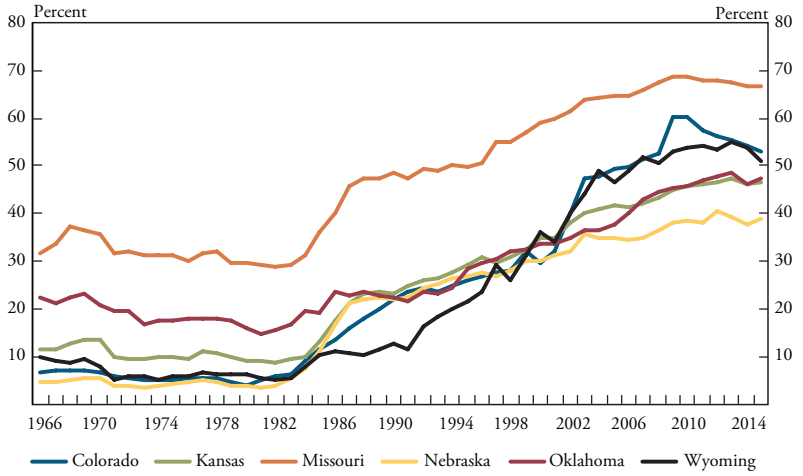
Chart 5

Farmland Loan Values



Source: FDIC.

Chart 6
Farm Real Estate Loan Value, Percent of Total Loans



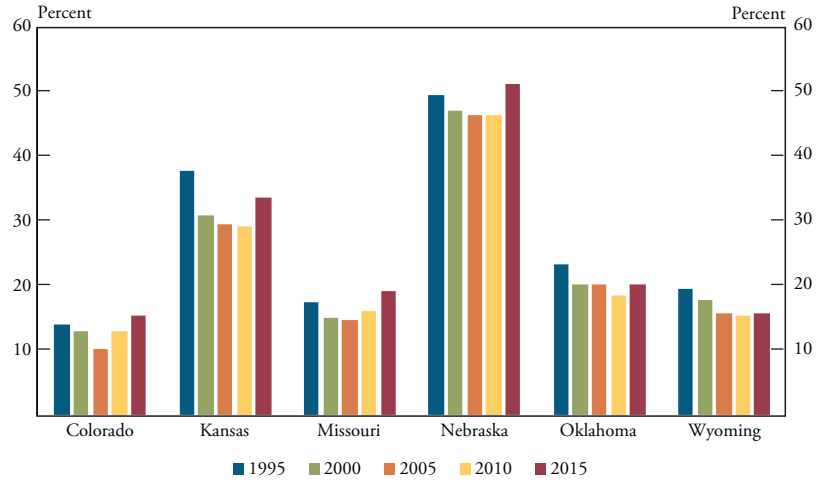
Source: FDIC.

Missouri (59 percent). The portfolio of loans financing agricultural real estate has shifted as the number of financial institutions has declined.

As banks consolidate, concerns in the agricultural industry have grown about the availability of funds to finance agriculture by commercial banks. Using FDIC data, I calculate the agricultural loan values of each bank as a percentage of state total loan values made by commercial banks for 1995, 2000, 2005, 2010, and 2015. Agricultural loans for this analysis are the sum of production agricultural loans and agricultural real estate loans. I calculate the average by state to examine whether the decreasing number of banks has changed the share of agricultural lending (Chart 7). The importance of agricultural lending differs by state within the Tenth District. Historically, nearly 50 percent of loan values in Nebraska finance agriculture. The agricultural share is near 30 percent in Kansas and between 10 percent and 20 percent in Colorado, Missouri, Oklahoma, and Wyoming. Average agricultural loan values to total loan values generally decreased through 2010 but increased after. Commercial banks appear to have shifted their lending portfolios to agriculture during the high profitability period for production agriculture.

Chart 7

Average Agricultural Loans, Percent of Total Loans



Source: FDIC.

The percent of banks offering production agricultural loans and farmland loans since 1995 has increased in each state in the Tenth District (Table 4). In 2015, 76.9 percent of banks made agricultural loans in Colorado, 96.3 percent in Kansas, 91.6 percent in Missouri, 98.4 percent in Nebraska, 97.6 percent in Oklahoma, and 96.9 percent in Wyoming. In the same year, 65.9 percent of banks made agricultural real estate loans in Colorado, 90.8 percent in Kansas, 83.2 percent in Missouri, 96.3 percent in Nebraska, 91.0 percent in Oklahoma, and 90.6 percent in Wyoming. Thus, agricultural lending has remained an important activity in the Tenth District. Bank consolidation does not appear to have reduced the importance of agricultural lending in the remaining commercial banks.

Table 4 also reports the shares of state agricultural loans made by the largest agricultural lender, the 10 largest agricultural lenders (CR 10), the 20 largest agricultural lenders (CR20), and the 30 largest agricultural lenders (CR30) in each state for 1995, 2000, 2005, 2010, and 2015. Comparing these shares provides information on whether agricultural lending has become more concentrated in a few institutions or several institutions. The market share of the largest agricultural lender has been increasing since 1995 in Colorado, Missouri, Nebraska, and

Table 4

Agricultural Lending Concentration on December 31

Variable	Colorado (percent)	Kansas (percent)	Missouri (percent)	Nebraska (percent)	Oklahoma (percent)	Wyoming (percent)
	2015					
Percent of banks with ag loans	76.9	96.3	91.6	98.4	97.6	96.9
Percent of banks with farmland loans	65.9	90.8	83.2	96.3	91.0	90.6
Top ag lending market share, percent	21.2	3.1	7.1	12.8	10.3	32.0
Top 10 bank market share, percent	62.8	23.4	28.6	39.1	38.2	78.9
Top 20 bank market share, percent	82.9	38.1	41.2	51.8	51.2	94.1
Top 30 bank market share, percent	92.4	48.2	50.3	60.6	60.3	99.9
	2010					
Percent of banks with ag loans	71.8	93.3	86.3	94.6	94.8	89.2
Percent of banks with farmland loans	61.5	89.0	77.4	93.3	88.7	86.5
Top ag lending market share, percent	13.4	3.0	5.1	10.7	9.9	18.2
Top 10 bank market share, percent	56.9	20.6	23.4	35.5	36.3	72.4
Top 20 bank market share, percent	76.3	34.6	35.1	47.5	48.7	92.0
Top 30 bank market share, percent	87.0	44.4	43.8	56.7	56.9	99.5
	2005					
Percent of banks with ag loans	62.2	91.6	83.1	93.8	93.0	86.0
Percent of banks with farmland loans	51.2	87.6	79.1	92.2	89.0	90.7
Top ag lending market share, percent	13.5	4.7	5.5	10.6	8.8	18.9
Top 10 bank market share, percent	54.9	21.4	23.0	33.2	32.0	70.9
Top 20 bank market share, percent	72.9	33.9	33.8	44.5	44.8	90.5
Top 30 bank market share, percent	83.3	42.9	41.4	53.0	54.1	98.1

Table 4 (continued)

Variable	Colorado (percent)	Kansas (percent)	Missouri (percent)	Nebraska (percent)	Oklahoma (percent)	Wyoming (percent)
	2000					
Percent of banks with ag loans	66.0	91.1	83.5	92.8	91.2	86.0
Percent of banks with farmland loans	55.5	90.6	79.1	91.1	88.1	86.0
Top ag lending market share, percent	12.0	3.7	4.9	9.0	7.8	20.7
Top 10 bank market share, percent	47.1	20.7	22.8	34.2	34.5	65.6
Top 20 bank market share, percent	64.6	32.3	31.7	44.0	45.8	83.7
Top 30 bank market share, percent	76.1	40.8	39.2	51.3	54.0	95.1
	1995					
Percent of banks with ag loans	62.8	91.9	83.8	93.7	89.9	84.2
Percent of banks with farmland loans	61.9	89.5	79.7	94.0	90.1	89.5
Top ag lending market share, percent	10.3	6.9	4.2	3.8	5.0	32.7
Top 10 bank market share, percent	42.4	18.1	18.7	23.3	23.1	69.7
Top 20 bank market share, percent	58.6	27.1	26.9	32.7	33.6	86.3
Top 30 bank market share, percent	69.8	34.0	33.7	40.2	41.4	93.9

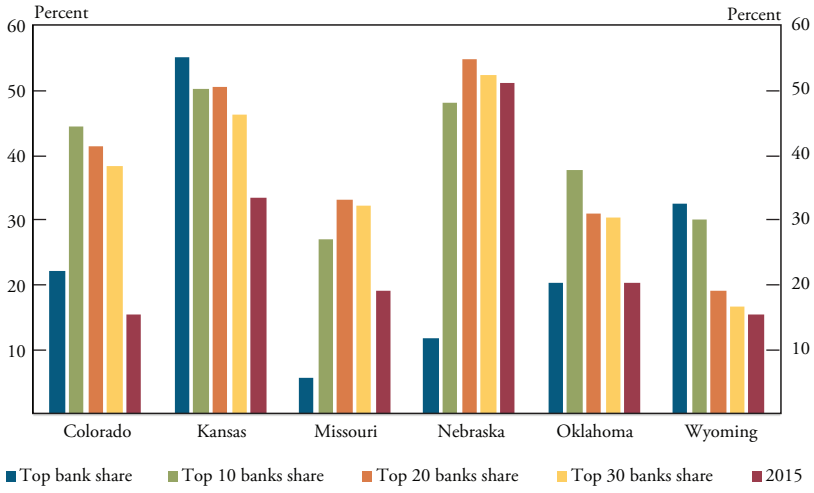
Oklahoma. The state agricultural lending share held by the largest agricultural commercial bank—in terms of loan value—in 2015 was highest in Wyoming (32.0 percent) and lowest in Kansas (3.1 percent). The share held by the 10 largest agricultural commercial banks has generally increased since 1995. In 2015, the largest 10 banks in Colorado and Wyoming held 62.8 percent and 78.9 percent of the state agricultural loan value. The share held by the top 10 banks in other states ranged from 20 percent to 40 percent.

The share of the state agricultural lending market held by the 20 and 30 largest agricultural lenders has generally increased since 1995 (Table 4). The largest 20 banks in Colorado and Wyoming held 82.9 percent and 94.1 percent of state agricultural loan value in 2015, respectively. In the other states, the share ranged from 35 percent to 55 percent. The largest 30 banks in Colorado and Wyoming held 92.4 percent and 99.9 percent of state agricultural loan value, respectively, while the share ranged from 48.2 percent to 60.6 percent in the other states. Agricultural lending is much more concentrated in Colorado and Wyoming compared with Kansas, Missouri, Nebraska, and Oklahoma. This may be the result of differences in state lending and other regulations.

Chart 8 shows agricultural lending as a percentage of total lending for the largest agricultural lending bank, the top 10 agricultural lending banks, the top 20 agricultural lending banks, and the top 30 agricultural lending banks for each state in the Tenth District. In agricultural banking research, a bank is often considered an agricultural bank if it lends 25 percent or more of its total market share to agriculture (Featherstone and Moss). Only in Kansas and Wyoming is the bank with the largest share of agricultural loans an agricultural bank. In all states but Wyoming, the average share of lending to agriculture is above 25 percent for the top 10, top 20, and top 30 banks. In Wyoming, the average share of agricultural lending is above 25 percent for the top 10 banks, while the average share for the top 20 and top 30 banks is below 25 percent. Researchers studying agricultural banking may want to consider whether a fixed market share amount is appropriate for the analysis of commercial bank agricultural lending.

Chart 8

Average Agricultural Loans, Percent of Total Loans



Source: FDIC.

III. The Farm Credit System

The Farm Credit System has also experienced consolidation and is the key competitor to commercial banks. The current institutions located in each state in the Tenth District are reported in Table 5. Colorado is predominantly served by three organizations: two are located within Colorado, and one is located outside of Colorado (FCA). Missouri is predominantly served by two Farm Credit organizations. Kansas is predominantly served by five organizations. Nebraska and Wyoming are served by the same Farm Credit organization that also serves Iowa and South Dakota. Oklahoma is predominantly served by five organizations. The lending values for each of the organizations as of December 31, 2015, are also reported in Table 5.

The table allows for a comparison between the value of agricultural lending by Farm Credit Associations and by commercial banks in Kansas, Missouri, and Oklahoma, thereby indicating the relative importance of the two types of organizations.[4] The agricultural loan value for a state is the sum of the loans held by its commercial banks and Farm Credit institutions. The percentage of loans made by Farm Credit institutions in 2015 was 35.3 percent in Kansas, 35.4 percent in Missouri, and 31.8 percent in Oklahoma, respectively. In Kansas,

Table 5
Farm Credit Institutions and Loans, 2015

Farm credit institution	Loan volume (millions of U.S. dollars)
Colorado	
Premier ACA	651.8
Southern Colorado ACA	943.8
Kansas	
Southwest Kansas ACA	736.7
High Plains ACA	751.7
Western Kansas ACA	361.9
Frontier ACA	1,856.4
Ness City, FLCA	342.3
Missouri	
Progressive FCS, ACA	591.4
FCS Financial, ACA	3,486.2
Nebraska and Wyoming	
FCS of America ACA	23,967.2
Oklahoma	
Chisholm Trail ACA	289.3
Western Oklahoma ACA	752.7
AgPreference, ACA	223.7
Enid ACA	205.3
East Central Oklahoma ACA	775.2

Note: "Nebraska and Wyoming" covers Iowa and South Dakota as well.
Sources: Farm Credit Administration, Call Report Data for Download.

all five Farm Credit institutions held a larger agricultural loan portfolio than the largest commercial bank agricultural lender. In Missouri, both Farm Credit institutions held a larger agricultural loan portfolio than the largest commercial bank agricultural lender. In Oklahoma, the largest two agricultural lenders are Farm Credit institutions, the third and fourth largest lenders are commercial banks, and the next largest lenders are the remaining three Farm Credit institutions.

I make similar comparisons for Kansas, Missouri, and Oklahoma in 2005 to examine the change over the last decade. In 2005, Kansas had six Farm Credit institutions, Missouri had two institutions, and Oklahoma had seven institutions. From 2005 to 2015, the number of Farm Credit institutions in Kansas fell by one, and the number of institutions in Oklahoma fell by two. Missouri had the same number

of institutions in both 2005 and 2015. The percentage of loans made by Farm Credit institutions in 2005 was 34.9 percent in Kansas, 33.2 percent in Missouri, and 26.2 percent in Oklahoma. The percentage of loans increased substantially in Oklahoma since 2005 but remained nearly the same in Kansas and Missouri. In Kansas, the four largest agricultural lenders were Farm Credit Associations followed by a bank and then the remaining two Farm Credit Associations. Both Farm Credit institutions in Missouri held greater loan values in 2005 than the largest commercial bank agricultural lender. In Oklahoma, the largest 10 agricultural lenders were (in descending order) a Farm Credit institution, a commercial bank, a Farm Credit institution, a bank, three Farm Credit institutions, two commercial banks, and a Farm Credit institution. From 2005 to 2015, consolidations in the Farm Credit System in Kansas and Oklahoma created agricultural lending entities larger than the agricultural loan value of the largest commercial banks.

IV. Implications

The previous analysis suggests there is substantial heterogeneity among Tenth District states regarding the consolidation of farms, the consolidation and agricultural lending practices of commercial banks, and the structure of the Farm Credit Associations. Thus, heterogeneity across the District must be considered when analyzing policy prescriptions and the financing of agriculture and rural communities in the future.

Both Langemeier and Boehlje and Saitone and Sexton indicate that additional vertical coordination is expected to occur in the agricultural and food supply chain in the future. Barry, Sonka, and Lajili suggest that vertical coordination and financial structure are intertwined. They argue that with more complex coordination among firms, asymmetric information becomes more problematic and monitoring more relevant as the lender knows less about the goals of the borrower and the characteristics of the productive assets. Financial risks will shift as production moves from an undifferentiated output to a more differentiated output.

Featherstone and Sherrick provide evidence that one of the motivations for a more coordinated system is the ability to obtain financing. They argue that coordination can increase the opportunities for obtaining credit through both traditional suppliers of credit—such as commercial banks and the Farm Credit System—and nontraditional

suppliers of credit—such as input suppliers or output processors—or through a broader access to bond and equity markets.

Duncan and Stam examine the lending environment looking forward to the 21st century. They argue that "while the trends toward scale, complexity, and technological advancement are pervasive across commercial-scale farms, smaller, specialized, or simpler business enterprises remain abundant and offer interesting market niches to lenders who wish to concentrate on certain market segments" (p .1). While that statement is nearly 20 years old, it continues to be appropriate for today's lending environment.

In regions of the United States where consolidation is rapidly occurring, agricultural lending institutions will need to be able to either enhance their ability to meet the financing needs through price competition or develop the ability to bundle services that larger production units may demand. Certainly, these services may include off-balance sheet income opportunities that Wheelock and Wilson (2012) suggest lead to increased economies of scale in the U.S. banking industry. The classic profit margin versus volume trade-off becomes critical for financial institutions to strategically consider as they strive to meet the needs of larger, more complex farms. Some financial institutions have moved into providing services such as crop insurance, record keeping, and tax services, either as profit centers or as loss-leaders to retain their current customers. Certainly, keeping abreast of the services larger, more complex farms demand is critical in developing bank strategy.

Conversely, in many other regions of the United States, the focus is on local food. This food is produced using high tunnel technology or other climate-controlled technology that allows fruit and vegetables to be produced close to urban centers through much or all of the year. Some of the financing for these facilities arise from the Small Business Administration lending programs and other less traditional sources of capital for agriculture. These nontraditional farms may provide a niche lending market in the future.

The economies of size that Wheelock and Wilson (2017) identify suggest that banks and other agricultural lenders will consider consolidation in the future. Economies of scale, whether due to the efficiency of information technology or regulation such as lending limits to individual borrowers, certainly remain important drivers of merger activity.

In addition, managerial or ownership capabilities in rural areas can lead to consolidation as a local bank faces a transition in management. Often, generational transitions provide an impetus for consolidation, whether it be in production agriculture, agribusinesses, or lending. Often the most profitable and effective opportunity for exit for existing owners or managers is to transition assets to more vibrant economic agents.

V. Conclusions

The heterogeneity of consolidation in production agriculture and agricultural lending is an important factor to consider in the future. Consolidation is not a monolithic occurrence across the United States. Within the Tenth Federal Reserve District, the consolidation of production agriculture is occurring at substantially different rates across states. Since 1980, Kansas, Missouri, Nebraska, and Oklahoma have seen a decrease in the number of farms, while Colorado, Oklahoma, and Wyoming have seen an increase. More than 80 percent of farms in Colorado, Missouri, and Oklahoma had annual sales of less than $100,000, while more than 20 percent of farms in Nebraska had annual sales greater than $500,000. Thus, the trend of increasing farm size is not consistent across states. In addition, the demand for debt does not increase in a linear fashion as farm size increases. Generally, larger farms are more leveraged. Differences in the production capabilities lead to alternative strategic objectives as one considers the financing of those organizations.

As with production agriculture, the industry structure of commercial banks and Farm Credit Associations is heterogeneous across states. The number of commercial banks ranges from 30 in Wyoming to 279 in Missouri. As the banking industry has consolidated, the value of agricultural lending provided by the remaining commercial banks has increased. Thus, in aggregate, fewer institutions are lending more dollars to agriculture. In addition, the mix of agricultural lending differs across the district. The share of lending for agricultural real estate by commercial banks is higher in Missouri and lower in Nebraska. Nearly 50 percent of the loan portfolio of commercial banks in Nebraska is agricultural lending, compared with less than 20 percent in Colorado and Wyoming. Agricultural lending is more concentrated among banks in Colorado and

Wyoming than among banks in Kansas, Missouri, Nebraska, and Oklahoma. In addition, competition from the Farm Credit System differs among states, ranging from a single Farm Credit institution in Nebraska and Wyoming to five institutions in Kansas and Oklahoma.

With the heterogeneity within agriculture and the consolidation that has occurred in the banking sector, it is apparent that agricultural lending remains an important activity for commercial banks. In some cases, consolidation has enhanced the importance of agricultural lending. Research on economies of scale in banking suggests that consolidation in the financial services industry is likely to continue due to the cost savings associated with information technology and off-balance-sheet income opportunities into the future. As agriculture becomes more heterogeneous, opportunities exist for those financial institutions to appropriately position themselves to take advantage of those opportunities whether through competition on price or competition through services.

Endnotes

[1]The Tenth District, which the Federal Reserve Bank of Kansas City serves, consists of all counties in Colorado, Kansas, Nebraska, Oklahoma, and Wyoming. It also includes 43 counties in western Missouri and 15 counties in northern New Mexico. Since much of the data used is at a state level and cannot be subdivided within the state, I consider Colorado, Kansas, Missouri, Nebraska, Oklahoma, and Wyoming.

[2]The $500,000 to $1,000,000 and greater than $1,000,000 categories are not available for all periods. Therefore, I combine those categories into a greater than $500,000 category. In addition, data are not available for Wyoming for all years.

[3]The debt-to-asset ratios use a market valuation of assets.

[4]Colorado, Nebraska, and Wyoming were not able to be calculated due to some territories within each state being served by organizations that cross state lines.

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Consolidation, Concentration, and Competition in the Food System

By James M. MacDonald

There are powerful movements toward consolidation throughout the food system and toward high concentration—with only a few buyers or sellers—in many of its markets. Some consolidation follows from economies of scale and innovation and can therefore be a channel for productivity growth. However, high concentration can, in some circumstances, lead to reduced efficiency, reduced innovation, and slower productivity growth.

I use the term "consolidation" to refer to shifts in production to larger farms and firms; in the context of mature, slow-growing industries, such shifts also imply fewer farms and firms. Agriculture is consolidating, but it is not very concentrated, because there are still many producers of almost all specific commodities. However, farms do face high and growing concentration in many markets with only a few suppliers of inputs or services or only a few buyers of farm products.

Rising concentration across the U.S. economy has become a matter of widespread comment and concern in recent years. Some public policies are directly concerned with concentration, primarily the effect of concentration on competition. However, farm consolidation also affects the design and effectiveness of farm, trade, and environmental policies that are not directly concerned with concentration or consolidation.

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In this article, I summarize consolidation and concentration in the food system and distinguish those policies that are directly aimed at the effects of concentration from those aimed at consolidation. I focus first on dairy farming, because it provides a canonical example of dramatic consolidation and of some key points regarding policy, and then expand the story to the rest of U.S. agriculture. Finally, I discuss the food system outside of agriculture, where the policy emphasis shifts more to competition and antitrust policy.

I. The U.S. Dairy Sector as a Striking and Canonical Example

In 1987, 202,068 farms maintained 10.1 million milk cows. By 2012, total milk production had grown by 44 percent while using fewer cows (9.3 million). But 2012 production came from just 64,098 farms—a 70 percent reduction in farms over 25 years.

Those statistics from the U.S. Department of Agriculture (USDA) imply that the average herd size nearly tripled, from 50 to 145 cows. However, using averages actually understates the sector's structural change. Table 1 reports midpoint values for milk cows and other livestock—half of all milk cows are in herds that are no larger than the midpoint, and half are in herds that are at least as large.[1] In 1987, the midpoint was 80 cows—in other words, half of U.S. dairy cows were in herds with at least 80 cows, and half were in herds with no more than 80. The midpoint grew rapidly after 1987, as farms with 2,000 or more cows began to multiply; the midpoint was 140 cows in 1997, 570 cows in 2007, and 900 cows in 2012.

Larger dairy farms generally realize substantial cost advantages over smaller farms (Mosheim and Lovell). Estimates of the cost of milk production from the USDA's Economic Research Service indicate that farms with herds of 2,000 or more cows had, on average, 16 percent lower production costs per hundredweight of production than farms with herds of 1,000–1,999 cows and 37 percent lower production costs than farms with 200–499 cows (MacDonald, Cessna, and Mosheim). The striking changes in herd size were accompanied by regional shifts in production to the West and by expanded reliance on purchased instead of homegrown feed. However, milk production did not see the

Table 1
Consolidation in Livestock Sectors

Commodity	1987	1997	2007	2012
	Sales midpoint: number of head sold or removed in year			
Broilers	300,000	480,000	681,600	680,000
Fed cattle	17,532	38,000	35,000	38,369
Hogs and pigs	1,200	11,000	30,000	40,000
Turkeys	120,000	137,246	157,000	160,000
	Inventory midpoint: number of head in herd/flock			
Beef cows	89	100	110	110
Egg layers	117,839	300,000	872,500	925,975
Milk cows	80	140	570	900

Note: The midpoint is the median of the distribution of animals by farm size: half of all animals are on farms that are at least as large as the midpoint, and half are on farms that are no larger.
Source: Economic Research Service calculations from unpublished census of agriculture records.

wide-ranging organizational changes that occurred in hog production at the same time; mostly, cows moved to much larger herds.

There has been no sustained policy effort to arrest dairy consolidation. This is a striking nondevelopment in light of the industry's dramatic consolidation—and, in particular, the sharp decline in the number of dairy farms.

However, some policy initiatives were aimed at supporting smaller operations. The Northeast Dairy Compact, for example, aimed to set wholesale prices for fluid milk within New England with the intention of protecting the viability of dairy farms—mostly fairly small—in the region. Later, the Milk Income Loss Contract program, initiated in the 2002 farm bill, provided countercyclical payments when farm milk prices fell below target levels. Payments were capped at relatively low levels of production, so the program provided greater support, per pound of milk production, to farms with herds no larger than 130–145 milk cows. Both programs had minor influence on small farm survival; to the extent they encouraged continued production from smaller herds and thereby reduced milk prices, they may have discouraged some large farm entry. However, these effects have been quite small (U.S. Department of Agriculture). In addition, no policy initiatives have aimed at directly slowing the entry and expansion of larger operations.

Consolidation did affect the design of existing policies related to dairy support and international trade. In 1987, dairy policy relied on

price supports both to manage the risks from price fluctuations and to support farmer incomes. However, given the wide range of production costs, large farms could make money, and have strong incentives to expand production and herds, at prices that failed to cover costs for small farms. As consolidation undermined policy, the United States moved away from reliance on price supports, and Congress eventually repealed the price support program in the 2014 farm bill.

The price support program sometimes resulted in U.S. milk prices that exceeded global prices, and dairy trade policy limited dairy product imports in response to those price differences while disposing of excess U.S. production through export subsidies. As production shifted to larger and lower-cost farms, industry average costs of production fell compared with what they would have been without consolidation, and the U.S. dairy industry became internationally competitive.[2] The combination of improved industry competitiveness and changes in trade policy led to sharp increases in U.S. commercial exports of dairy products starting in 2004 (MacDonald, Cessna, and Mosheim; Cessna and others).

In the short run, milk production is highly insensitive to prices; in consequence, modest movements in dairy demand can result in wide milk price fluctuations. The growing export competitiveness of the industry adds to those price risks, as changes in exchange rates or foreign production can affect U.S. milk demand. Moreover, many large dairy farms finance their expansion with bank loans, so that they carry large debt loads and a substantial liquidity risk in periods of low prices. In response, dairy policy has moved toward an emphasis on risk management through insurance-type programs, such as the Margin Protection Program introduced in the 2014 farm bill.[3]

Dairy consolidation has also affected environmental policy. Consolidating production also consolidates manure, which carries environmental risks. Manure storage facilities can fail, and if manure is applied to cropland in amounts that exceed the crops' agronomic capacity to absorb nutrients, nearby groundwater and surface water can be contaminated. Most large-scale dairy farms are classed as concentrated animal feeding operations (CAFOs) under the Clean Water Act and are subject to rules for reporting, storing, and managing manure under the

Act. CAFOs are also subject to state regulation and are frequently the focus of state and local litigation over the siting of new dairy facilities.

In summary, the dairy industry has undergone dramatic consolidation. Although there were no serious attempts to slow consolidation through policy, the industry's rapid consolidation did influence commodity, trade, and environmental policies. This pattern appears elsewhere in agriculture.

II. Consolidation in the Rest of Agriculture

Other livestock sectors have undergone major structural changes (Table 1). The midpoint sizes of hog and egg–laying farms increased dramatically from 1987 to 2012. Over the same period, broilers, turkeys, and fed cattle, which underwent wide-ranging reorganizations in the 1960s and 1970s, continued to shift to larger operations.[4] Note that beef cows (cow-calf operations) are an outlier. The cow-calf sector has seen little significant change in organization, and the pasture and rangeland that supports it has not become more consolidated.

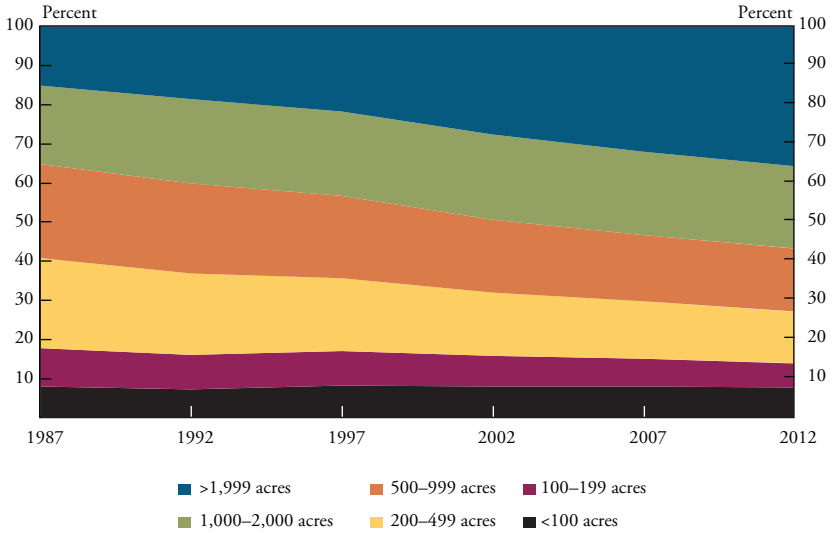
Consolidation in livestock, where it has occurred, has been dramatic and episodic, with major changes occurring in fairly short time periods. Consolidation in crop production has been a bit different. From 1987 to 2012, cropland shifted away from farms with 100–999 acres of cropland, whose aggregate acreage share fell from 57 to 36 percent, and toward farms with at least 2,000 acres, whose acreage share grew from 15 percent to 36 percent (Chart 1).

The cropland midpoint shows the farm size that splits the distribution of acreage: half of all cropland acres are on farms with no more than the midpoint acreage, and half are on farms with no less. That midpoint grew persistently between each census over 1982–2012, and the aggregate increase was substantial, from 589 acres in 1982 to 1,201 acres in 2012 (Chart 2).[5] Similarly, midpoints for major field crops grew substantially and persistently as cropland shifted to larger corn, cotton, rice, soybean, and wheat operations (Chart 3).

In further work, MacDonald, Hoppe and Newton calculate midpoints for harvested acres for 55 crops over 1987–2012: 15 field crops, 20 vegetable and melon crops, and 20 fruit, tree nut, and berry crops. Consolidation in these crops was widespread—midpoints increased for 53 crops. Consolidation was also substantial: the midpoints for 40 of

Chart 1

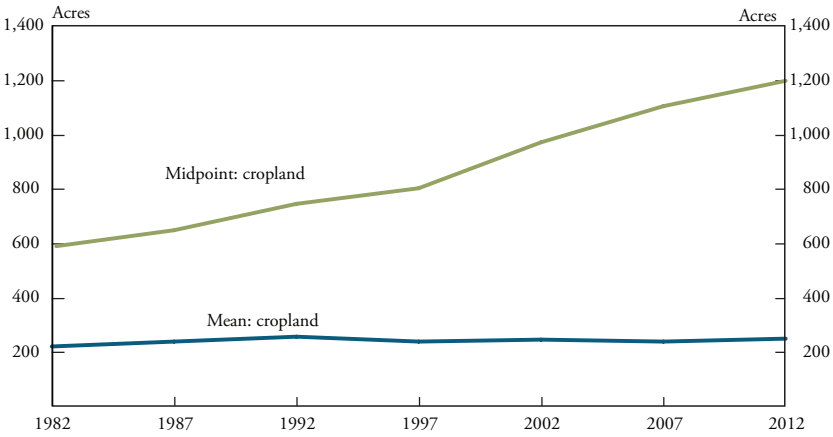
Shifts in Cropland Among Acreage Size Classes, 1987–2012



Source: Economic Research Service calculations from unpublished USDA Census of Agriculture records.

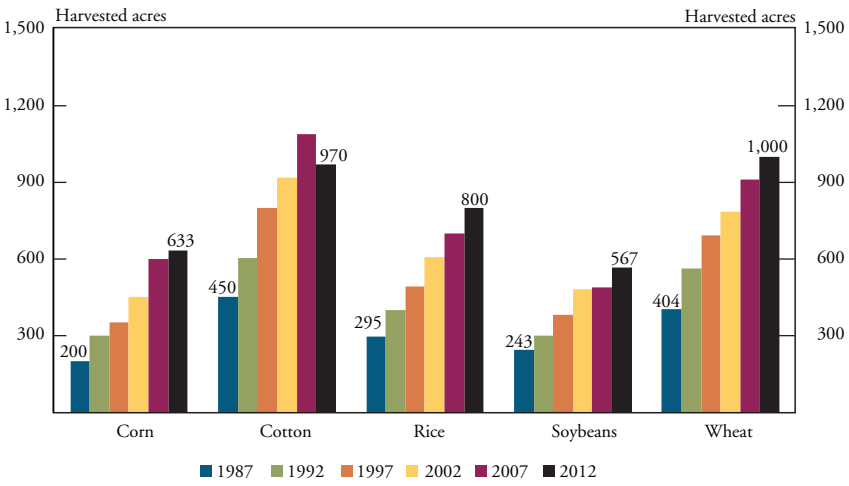
Chart 2

Cropland Is Consolidating



Note: Half of all cropland acres are on farms with at least the midpoint acreage, and half are on farms with no more.
Source: Economic Research Service calculations from National Agricultural Statistics Service, census of agriculture.

Chart 3
Midpoints for Major Field Crops, 1987–2012



Source: Economic Research Service calculations from unpublished census of agriculture records.

55 crops at least doubled, with a median midpoint increase of 133 percent. And consolidation was also persistent, steadily increasing in each five-year census period.

Why has crop acreage and production shifted to larger farms? The broad pattern of consolidation, covering livestock as well as crops not supported by commodity programs, suggests that commodity programs cannot be the major driver.[6] Instead, technology has likely played a major role (MacDonald, Korb, and Hoppe). Specifically, the equipment used in field tasks—for ground preparation, planting, spraying, and harvesting—has become steadily larger and faster, allowing a single farmer or farm family to manage more acres. Several other important "labor-saving" innovations, such as chemical pesticides, herbicide-tolerant seeds, and reduced tillage, have reduced the time needed for farm operations on a given land area, thus increasing the amount of land that a farmer or farm family can manage. Finally, equipment has also become "smarter" by incorporating information technology that allows for autosteering, variable application of nutrients and chemicals, and yield monitoring within fields. This technology carries substantial fixed costs, which may create economies of scale, and is far more likely to be adopted on larger farms (Schimmelpfennig). These examples concern

crops, but technologies that generate scale economies in some processes—and that provide opportunities to regularize production by moving it indoors and substituting capital for labor—also support larger livestock operations (Allen and Lueck).

As in the dairy example, no policies currently aim directly at farm structure, nor do any aim to arrest consolidation, though a few such policies were proposed in the livestock sector. Specifically, proposals made during the 2002 and 2008 farm bill debates would have banned packer ownership of livestock and limited the use of the marketing and production contracts that have been integral to the extensive reorganization and consolidation of hog and poultry production while also governing the sale of most fed cattle. I will not dwell on the details of the proposals, nor on the extensive research surrounding the use of such contracts (see, generally, RTI International), but will simply note that those efforts failed, and that agricultural consolidation proceeded without significant policy constraints.

Why are there no policies regarding structure? Agriculture is a competitive industry. Absent concerns with monopoly power, changes in farm structure are viewed as farmers' responses to changes in technology and to prices for inputs and outputs. Those who respond most effectively will tend to realize lower costs and growing shares of land and production. Structural change then becomes a vehicle for agricultural productivity growth.[7] If structural change exacerbates externalities like water or air pollution, then the policy response has been to deal directly with the externality, rather than with structural change.

In recent years, the locus of direct federal support for agriculture has shifted away from price supports and direct payments and toward risk management under crop insurance, with support in the form of premium subsidies. Consolidation has likely influenced that shift.

Operators of larger farms realize higher household incomes than operators of small and midsize farms. Since commodity program payments reflected acreage and production devoted to certain field crops, consolidation that shifted acreage and production to larger farms also shifted program payments to higher-income households (White and Hoppe). When commodity programs were initiated in the 1930s, one could argue that they served as income support and antipoverty programs, since farm household incomes were well below the averages for

all U.S. households (Gardner). That is a much more difficult argument to make today. Program proponents are now more likely to couch federal commodity and insurance programs as a "safety net" in the event of sharp declines in commodity prices and household incomes. Indeed, the household incomes of the operators of commercial farms do show far more variability over time than household incomes in the broader economy (Key and others).

III. Concentration in Agribusiness

Agribusiness industries that buy from or sell to farmers have become more concentrated (Table 2). Since the late 1970s, most basic commodity processing industries—as well as industries that provide key farm inputs or services such as seeds, machinery, chemicals, or rail freight—have seen large increases in concentration. Livestock slaughter industries consolidated sharply during the 1980s and 1990.

The trend toward higher concentration is not unique to agribusiness, but is apparent across the U.S. economy, a development that has attracted considerable notice in recent years (Council of Economic Advisers; Baker; Peltzman; *The Economist*). High concentration can facilitate the exercise of monopoly power by sellers (or monopsony power in the case of buyers). The classic concern with monopoly power is that it can lead to higher prices (lower in the case of monopsony power) thereby distorting production and consumption decisions and leading to losses in allocative efficiency. However, reduced competition can also lead to lower productive efficiency, reduced innovation, and slower productivity growth in affected industries. Moreover, these costs can be much larger than classic allocative efficiency losses (Holmes and Schmitz; Bloom and others; Lewis). More recently, some have argued that increased concentration plays a role in slowing growth and increasing inequality across the economy (Baker; Autor and others).

These issues are the primary focus of antitrust policy, which in turn focuses on three primary areas of enforcement: collusion, merger policy, and facilitating practices—business practices that might facilitate cooperation among firms or the exercise of monopoly power by individual firms (Posner; Hovenkamp). Collusion primarily concerns explicit agreements among rivals to fix prices or production; such agreements are per se violations of the antitrust laws, and the focus on

Table 2

Four-Firm Concentration Ratios (CR4) in Selected U.S. Agribusinesses

Largest four firms' share of:	Beginning year	Ending year
Manufacturing value of shipments (dollars)	Year=1977	Year=2012
Fluid milk processing	18	46
Flour milling	33	50
Wet corn milling	63	86
Soybean processing	54	79
Rice milling	51	47
Cane sugar refining	63	95
Beet sugar	67	78
Nitrogenous fertilizer manufacturing	34	69
Phosphatic fertilizer manufacturing	35	88
Pesticide manufacturing	44	57
Farm machinery	46	61
	Year=1980	Year=2007
Railroad grain shipments (ton-miles)	53	84
Seed value of shipments (dollars)	Year=2000	Year=2015
Corn seed	60	85
Cotton seed	95	91
Soybean seed	51	76
Livestock procurement (animals)	Year=1980	Year=2012
Steer and heifer slaughter	36	85
Hog slaughter	34	64
	Year=1995	Year=2012
Broiler processing	50	51
Turkey processing	41	53

Sources: U.S. Census Bureau; USDA Agricultural Marketing Service; Farm Journal; USDA Grain Inspection, Packers and Stockyards Administration.

explicit agreement drives an enforcement emphasis on evidence of conspiracies.[8] However, firms may refrain from competing vigorously with one another and may therefore be able to exercise monopoly power without explicit agreement. For this reason, merger policy focuses on identifying and deterring those mergers that might reduce competition, and policy also seeks to identify and deter those practices that might facilitate the exercise of market power by incumbent firms. I will focus on merger policy, because the merger issues that are relevant for concentration also relate to other enforcement.

Concentration and antitrust policy

Merger policy in the United States underwent a significant revision and easing in the 1980s (Posner; Hovenkamp; Peltzman). Two federal antitrust enforcement agencies—the Department of Justice (DOJ) and the Federal Trade Commission (FTC)—provide merger guidelines to acquaint interested parties with the standards currently applied in determining whether a merger would be challenged on antitrust grounds. The initial guidelines, in place from 1968 to 1982, placed heavy emphasis on concentration by specifying the combinations of market shares that would "ordinarily" lead to merger challenges.[9]

This issue—whether concentration is a sufficient indicator of the exercise of market power—received intense scrutiny in economic research in the 1970s and 1980s. "Sufficient" means that increases in concentration beyond some threshold could be expected, with a high degree of confidence, to lead to price changes (increases for monopoly, decreases for monopsony), irrespective of other market factors.[10]

Concentration does appear to be generally correlated with prices; the correlation is quite strong in some markets, indicating a considerable amount of market power, but weak in many cases and nonexistent in some (Bresnahan; Schmalensee; Weiss). The findings for agricultural markets mirror those for the broader economy: concentration matters in general, but the precise effects on prices vary widely and depend on a host of other factors. Some highly concentrated markets even appear to be quite competitive (Sexton; Adjemian and others). In short, empirical evidence does not support the use of concentration as a sufficient indicator of market power, and policy has followed suit.

Subsequent editions of the merger guidelines (most recently, 2010), raised the levels of concentration (and the merging firms'

market shares) that would "likely" lead to challenges and placed greater weight on other market attributes, such as the ease of entry into an industry, the ease with which customers of the merged firms can switch clients, substitute products, and efficiencies realized through a merger (U.S. DOJ and U.S. FTC).

As a specific example, consider a rare case of a highly concentrated agricultural market. Numerous media reports note that two large producers—Grimmway Farms and Bolthouse Farms—account for 80–90 percent of U.S. carrot production. Given this concentration, shouldn't the producers be able to raise product prices well above costs? The sufficiency argument, which emphasizes concentration alone, would say yes, but there are at least three mitigating factors to consider. First, if the producers did succeed in raising prices—which would require cuts in production—would the resulting profit opportunities attract other vegetable growers to carrot production? Second, how easily could major customers (who are primarily large retail chains) switch between carrot rivals or to new suppliers in the event of higher prices? Third, how rapidly would consumers substitute other products for carrots and carrot juice in response to higher prices? Easy entry, easy switching, and close substitutes would constrain the pricing of the leading growers and could leave the incumbents with little or no ability to impose and maintain non-competitive prices, even in a highly concentrated industry.

The easing of merger policy is not the only factor leading to increased concentration. Technology also influences the concentration of several industries, with expanded scale economies—combined with slow demand growth—playing an important role in food processing industries (see, for example, MacDonald and Ollinger), and agglomeration economies playing a role in many modern information technology and communications industries. Nonetheless, merger policy plays a role in increasing industry concentration, and Peltzman provides evidence that it has played an important role.

Effects of increased concentration on economic performance

Has increased agribusiness concentration harmed the sector's performance? Changes in the merger guidelines arose because of a view, supported by considerable empirical evidence, that increased concentration did not necessarily lead to increased monopoly power and the

costs associated with it. This view in turn relies on three principles: 1) the exercise of monopoly power is primarily of concern at high levels of concentration, with only a few firms competing with each other; 2) concentration alone is not a sufficient indicator of monopoly power; and 3) increases in concentration may reflect efficiencies—such as the realization of scale economies or the success of an innovating firm in expanding its sales—and we should therefore weigh the social costs and benefits to restricting concentration. However, these principles do not tell us that current practice is optimal, nor do they suggest the recent emergence of highly concentrated industries is costless.

In an influential recent book, Kwoka argues that actual merger policy has been considerably more tolerant of horizontal mergers (between competitors) than the guidelines would imply for all but the highest levels of concentration. He also finds that approved mergers frequently resulted in price increases, often substantial, as a result of the merger.[11]

Kwoka focuses on mergers that were "close calls"—horizontal mergers between relatively large firms that elicited initial interest and information requests from the agencies. His findings suggest that some mergers, and by extension some of the recent increases in concentration in markets that were already concentrated, led to losses in efficiency and productivity from the exercise of monopoly power. He argues that easing has gone too far and that merger policy should be more restrictive, though he certainly does not call for a return to the 1968 guidelines, nor does he argue for a simple and primary focus on industry concentration.

Kwoka's work focuses on the effect of competition and mergers on prices, which reflects a long tradition in economics (Bresnahan; Weiss; Adjemian and others). However, there is growing interest in the effects of concentration and mergers on innovation, particularly on the investments in research that lead to innovation. In the last two decades, antitrust enforcement agencies have been increasingly likely to cite potential reductions in innovation when they challenge mergers.

These issues carry particular resonance in agribusiness because of the importance of innovation and productivity growth in agriculture and because of the salience of innovation and research in recent agribusiness mergers. Specifically, the DOJ blocked Monsanto's proposed sale of Precision Planting LLC, a maker of high-speed planters, to John Deere, the other major producer. The DOJ argued that intense rivalry

between the two firms had led to improved prices for farmers and to the rapid introduction of innovative new features, and that the merger would reduce incentives to invest in further innovation by removing the threat of rivalry. In addition, while some observers have expressed concerns about the effects of the recent seed/chemical company mergers on prices, the firms are also major sources of research investments and innovation in crop seeds and crop protection chemicals.[12]

Most research and development (R&D) investments are carried out by large firms in industries that are at least moderately concentrated (Aghion and Griffith; Shapiro). Moreover, the links between concentration, R&D investments, and innovation are quite complex, not least because successful innovation can lead to increased concentration as the successful innovator attracts sales away from rivals. However, Shapiro provides a way to think about competition in innovation and applies the idea to merger policy. He distinguishes between the effects of a merger on a firm's *ability* to innovate and its *incentive* to innovate.

A merger may improve firms' ability to innovate when it combines firms with complementary research assets. For example, small pharmaceutical research firms may not have the expertise in clinical testing and regulatory review necessary to bring a new drug to approval and marketing; merging with a larger firm is a common way to combine applied research expertise with expertise in clinical testing and product development.

However, a merger may also reduce a firm's incentive to innovate. A firm with no rival may have limited incentive to invest in R&D, because new products would largely be cannibalizing from their own sales—the expected returns from R&D are lower for these firms than for firms whose successful innovations would pull sales from rivals. As a result, a merger between the two dominant producers of a technology may reduce the combined firm's incentive to innovate, because new products will largely draw sales away from its existing products rather than from rival products (Arrow).[13]

In contrast, a large firm with a dominant market share may still have incentives to invest in innovation if it fears a rival may scoop it with a major new innovation that would undermine its present position (Aghion and Griffith). These incentives are more likely if the firm has rivals in technological innovation and if new technologies can provide major leaps forward. For these reasons, Shapiro argues that

innovation concerns should matter when a merger combines rival innovators from a small existing pool. More broadly, concentration may discourage innovation when firms have no fear that rivals will scoop them, as well as when they are concerned that their own innovation will cut into their existing sales.

IV. Conclusion

Competition matters for economic performance. There is powerful evidence that more competitive industries innovate more, realize more rapid productivity growth, and are more responsive to consumer demands (Baker; Bloom and others; Lewis; Shapiro). However, American industry—including American agribusiness—is becoming more concentrated. Does increased concentration portend declining competition?

Increased concentration does not necessarily imply reduced competition. Competition can itself cause increased concentration; absent the possible reverse causality, the link between concentration and competition is conditional on other key market factors and is more likely to be of concern at high levels of concentration. It is this understanding, widely shared among economists who study the issue, that has led to substantial changes in antitrust and competition policy over the last four decades—and these changes are one source of increased concentration.

However, recognizing that the link between concentration and competition is conditional and complex does not mean accepting current levels of concentration as ideal. Considerable evidence suggests that some industries are not particularly competitive, many of which are also highly concentrated.

Competition policies, including antitrust, are influenced by politics; elections matter, by affecting leadership and enforcement priorities at federal agencies. Ideology also matters: the shifts in merger policy in the 1980s were part of a broad shift toward greater reliance on market outcomes in pursuit of national goals.

But analysis and evidence matters as well. Antitrust policy is strongly influenced by the broadly held views of influential judges, academics, and the antitrust bar, which are in turn influenced by an extensive academic literature combining applied economic and legal theory and empirical analyses. In fact, the major shift in merger policy in the 1980s did not stem from congressional or White House action but was instead

initiated by the DOJ in response to developing views of lawyers and economists (Posner; Hovenkamp). The United States is currently in the midst of another vigorous discussion of concentration, competition, and policy in the economy and agribusiness. In my view, the outcome of that discussion will depend to a great extent on the continued accretion of evidence on the nature of competition and the effects of policy decisions.

Endnotes

[1]The midpoint is *a* median—the median of the distribution of cows by herd size—as distinct from the simple median of the distribution of farms by herd size (such that half of all farms are larger than the simple median, while half are smaller). Midpoints are useful for summarizing highly skewed size distributions: see Lund and Price or MacDonald and others.

[2]MacDonald, Cessna, and Mosheim estimate that consolidation, by shifting production to lower cost operations, reduced average U.S. dairy production costs by 19 percent from 1998 to 2012.

[3]While dairy farmers have been reluctant to purchase anything more than catastrophic coverage under the program, the National Milk Producers Federation aims to adjust the program's parameters in the next farm bill, rather than replace it.

[4]Dairy, egg, and cow-calf operations all produce products from herds or flocks on site, so inventories (herd or flock size) are used to measure size. Broilers, fed cattle, hogs, and turkeys are placed on an operation to be raised under contract and removed at the end of a production stage. In feeding operations, annual "sales and removals" (production) is a better basis for measuring size than inventories.

[5]Note that the mean farm size changed very little (Chart 2). The number of midsize farms (100–999 cropland acres) fell by 45 percent from 1987 to 2012, but the number with 1–9 acres grew substantially, in part because the farm definition (at least $1,000 of actual or potential sales) is not adjusted for inflation. With modest declines in total cropland and in the total number of farms with cropland, the mean size changed little even as land shifted to much larger farms.

[6]Separate analyses have evaluated the role of crop insurance and federal disaster programs in spurring consolidation. By reducing the financial risks faced by farmers, the programs could have induced farmers to invest more time and money into farming activities, and the effects could be stronger among larger operations, thus spurring larger farms and consolidation. Thus far, research finds positive but small impacts of crop insurance on consolidation. For more detailed summary and references, see MacDonald, Korb, and Hoppe.

[7]Consolidation in hog and dairy production were accompanied by spurts of cost reduction and productivity growth (McBride and Key; MacDonald, Cessna, and Mosheim). Shifts of field crop production to larger operations account for about a sixth of observed productivity growth in that sector (Key).

[8]Important examples in agribusiness include the global price-fixing conspiracies in lysine, a feed additive, and vitamins (including those used in animal feed) in the 1990s, and in herbicide ingredients in 2001 (Connor).

[9]For example, in an industry with a four-firm concentration ratio (CR4) exceeding 74, mergers between firms with market shares of at least 4 percent would ordinarily have been challenged, while in less-concentrated markets, an acquisition of a firm with a market share of at least 4 percent by one with at least 10 percent would draw a challenge. Tighter thresholds applied where concentration had been rising.

[10]In a recent article, Pollan succinctly expresses the sufficiency view: "according to one traditional yardstick, an industry is deemed excessively concentrated when the top four companies control more than 40 percent of the market."

[11]See also Ashenfelter, Hosken, and Weinberg, who conclude, on the basis of a review of consummated mergers, "the empirical evidence that mergers can cause economically significant increases in price is overwhelming." Further support can be found in Blonigen and Pierce, who look at changes in pricing and efficiency in a large sample of establishments acquired in the period 1998–2006, when merger policy was relatively lenient. On average, there was no change in productivity following acquisition but a substantial increase in price mark-ups over marginal costs, especially in horizontal mergers. The study did not look separately at acquisitions in concentrated industries or at mergers that were "close calls" for the antitrust agencies.

[12]The proposals include the combination of Dow Chemical and Dupont, which would then spin off the combined agriculture (seeds and crop protection), material science, and specialty chemicals businesses into three separate firms; the acquisition of Syngenta by the state-owned Chinese firm ChemChina; and the acquisition of Monsanto by Bayer. The proposals would reduce the Big Six global seed and agricultural chemical firms to a Big Four.

[13]This relates to a product innovation. Higher market shares provide a stronger incentive for process innovations aimed at reducing the costs of existing products, because a cost reduction will be applied over a larger volume of production.

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