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FUNDAMENTAL FORCES AFFECTING LIVESTOCK PRODUCERS

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In a seminal *Harvard Business Review* article published in 1979, Michael Porter identified five competitive forces that shape industry competition, all of which feed into rivalry among existing competitors. Porter's framework has most often been applied to industries producing and marketing differentiated products. Conversely, U.S. livestock and milk production still mostly resembles a commodity market with largely undifferentiated products marketed to a processing sector that, based on the Herfindahl-Herschman Index (HHI)-an industry concentration measure based on market shares that is easily computed and compared across industries- and Department of Justice and Federal Trade Commission definitions, is unconcentrated to approaching moderately concentrated. Despite this distinction, we find that several aspects of Porter's forces are important in analyzing the U.S. livestock sector. The remainder of this article reviews the key aspects of Porter's five forces as they relate to the competitive structure of the U.S. livestock sector, plus two additional dynamic forces which we believe are also important; technology and drivers of change.

Rivalry Among Existing Competitors

Although inter-firm rivalry is one of Porter's key factors, it is not the primary force impacting profitability in the pork, beef, and dairy production sectors. All three industries are still characterized by a relatively large number of production firms and a relatively low HHI (Table 1), compared to nonagricultural industries in the United States. Consolidation has been occurring for a long time, but it has mostly been the result of unprofitable, high cost firms exiting the industry. In a broader sense, however, rivalry in the livestock sector can sometimes be viewed as taking place on a more regional or structural basis, rather than firm level. For example, traditional small herd milk producers in the upper Midwest may view large-scale dairies in the western states as rivals when market share shifted to these regions. High Plains cattle feedlots considered cattle feeders in the "ethanol belt" as rivals when energy policy supported higher corn prices and more abundant supplies of distillers' grains and solubles, an excellent corn substitute in cattle rations, near ethanol plants. Diversified crop-hog farms in the Midwest viewed large scale specialized hog production companies as rivals when new technology facilitated large scale production that was no longer tied to a land base led to a pork industry restructuring. Specialized pork producers focused on adopting new, cost-reducing technology and expanded while many diversified farms using older technology stagnated and found themselves at a cost disadvantage. In periods when production margins turned negative, older assets that were not well adapted to newer lower cost technology were often idled first. As the remaining assets were more difficult to retire, regions—and in some cases firms—behaved more like rivals that played out their response in the policy arena rather than the market place.

The broiler industry provides a glimpse of inter-firm rivalry for the red meat and milk sectors in the future. Firms invested heavily in branded products are reluctant to reduce production when margins are narrow for fear of losing market share to another firm. This type of behavior is more common at the processing level where firms have branded products and developed retailer relationships or contracts that will be lost to competitors if there are supply disruptions. As the hog, beef, and dairy production sectors consolidate into fewer and larger firms similar issues will arise. For example, supply agreements between production firms and processors have become commonplace and the need to keep the product pipeline full will make the decision-making process regarding production cutbacks more strategic and less reliant on simple marginal cost

economics.

Table 1

Herfindahl-Herschman Indices (HHI) for the Largest Firms in Selected Meat and Dairy Sectors.*

Sector	HHI, 4 Largest Firms	HHI, 8 Largest Firms
Beef packing	1430	1460
Pork packing	1180	1310
Milk cooperatives	540	575
Hog production	290	315
Cattle feedlots	60	70

Source: John Lawrence, Iowa State University.

*U.S. Department of Justice and the Federal Trade Commission categorize a market as "unconcentrated" if the HHI is less than 1500, "moderately concentrated" if the HHI falls between 1500 and 2500, and "highly concentrated" if the HHI exceeds 2500.

Examining each meat production sector closely reveals several differences. Beef production in the U.S. is fragmented, but the level of concentration varies greatly by industry segment. The cow-calf sector, which supplies calves to various intermediate production segments and to feedlots, is still heavily populated by small scale firms. For example, in 2007 nearly 90% of the 758 thousand U.S. farm operations with beef cows had an inventory of less than 100 cows (USDA, 2007). Conversely, feeding cattle to slaughter weight on high grain concentrate rations is much more concentrated, with the 10 largest firms in the industry marketing 22 to 29% of the steers and heifers processed for beef production (Mintert, 2003). Still, the HHI is well below 100 for these top firms. Economies of scale and scope in cattle feeding, combined with excess capacity, have largely driven the consolidation. Inter-firm rivalry has, historically, not been a significant driver of change in the cow-calf sector and that's expected to continue to be the case in the future. Large cattle feeding firms, however, are more likely to view each other as rivals in the future as they strive to be low-cost producers, fulfill a growing number of market niches often defined by branded products, and increase market share. Competition for improved technology providing advantages in cost of production and the ability to better meet customer needs is expected to be an industry driver in the future.

U.S. pork industry consolidation, which has been underway for several decades, recently reached the point that less than 200 firms, each marketing 50,000 or more hogs per year, produced nearly two-thirds of the hogs raised in the United States (Lawrence and Grimes, 2007). Furthermore, just 27 firms, each marketing at least 500,000 hogs per year, sold 43% of all U.S. hog production during 2006. In total, firms with annual sales over 10 thousand head accounted for 85% of U.S. hog production. The remaining 15% of hogs were sold by more than 54,000 firms, each of which marketed fewer than 10,000 hogs. Importantly, these smaller firms continue to lose market share as operations in the three larger size categories expand. In spite of the consolidation, the HHI for the four largest hog producers is under 300, well below the 1500-2500 required to be considered a moderately concentrated industry. Rapid restructuring to capture new cost reducing technologies fueled expansion by larger firms throughout the 1990s. More recently continued exodus of high cost producers, in addition to mergers and acquisitions, led to further industry consolidation. Productivity increases continue to outpace domestic demand growth and, therefore, it is likely that future growth of the U.S. pork industry will depend on export increases.

Even though the U.S. pork industry is much more concentrated than it was just a few years ago, inter-firm rivalry has not been a dominant consideration for industry participants. But the ability and desire to produce branded pork products is becoming a more important pork marketing strategy for some hog producers. As branded pork production becomes a more important part of hog producers' sales marketing strategy, it will

lead to increasing inter-firm rivalry.

Similar to the pork industry, the number of milk producers has been declining for many years. However, despite the long-term decline, there were still over 71 thousand operations with dairy cows in 2007 (USDA, 2007). The large number of firms in the industry has limited competition among firms and, as a result, internal rivalry has not been a significant issue. However, the pace of dairy industry consolidation is increasing rapidly. Over the last decade the only firm size category that gained market share was operations with 500 or more cows, and actually much of that increase was concentrated among dairies that milk several thousand cows. Still, it's likely to be some time before enough concentration occurs among dairy producers to fuel a high degree of inter-firm rivalry. In contrast, first purchasers of milk have become highly concentrated. Cooperatives market 82% of U.S. milk production and have sought to increase prices paid to milk producers through a voluntary dairy cow supply reduction program known as Cooperatives Working Together. Further, the Federal Milk Marketing Orders reduce the incentive to compete for fluid contracts for sales to retailers by blending minimum prices. Looking ahead, continued consolidation in herds or cooperatives could encourage dairy producers to vote to eliminate Milk Marketing Orders, which could lead to rising inter-firm rivalries as firms compete for retailer contracts.

Power of Buyers and Sellers

Bargaining power of buyers in the beef market place has been studied extensively by economists over a long period of time (Ward, 2010). Concentration among beef processors increased markedly over a span of several decades, but especially from the mid-1970s through the mid-1980s. By 2007, the four largest steer and heifer slaughter firms had a combined market share of approximately 80% and a HHI of 1430. Pork processors also consolidated and the four largest firms collectively processed 65% of barrow and gilts marketed in 2007 (USDA, 2009), resulting in a HHI of 1180. Processing technology changes meant that not only were firms larger, but plant sizes also became much larger. The transition to larger firm and plant sizes encouraged adoption of alternative procurement agreements to secure a consistent supply of livestock that met processors' quality specifications. The increase in efficiency that arises from operating plants near their optimum capacity, and the greater risk associated with operating larger plants, encouraged wide-spread use of longer-term supply agreements with livestock producers. At the same time, some larger livestock operations were interested in marketing agreements with processors that reduced risk by ensuring they had a market outlet for their production. The change in marketing and procurement practices has altered the bargaining power landscape as both buyers and sellers increasingly find longer-term contractual arrangements effective at managing risk.

Supplier bargaining power is relatively low in animal agriculture. Feed cost is the single largest expense for livestock, dairy and poultry production, often representing 60% or more of total production costs. There is new competition for corn from ethanol production but, because grain is a commodity, bargaining power is low. Other significant inputs, such as most pharmaceutical technologies and genetics have many close substitutes, which limits market power. Rivalry may exist among firms for key inputs, but sellers seldom have sufficient leverage to shape the industry. As sectors restructure or expand, competition for critical inputs can be a bottleneck to growth. Livestock firms compete for construction sites with preferred characteristics of transportation and utility access, land for manure application, and distance from neighbors. Firms not competing for company owned sites are often rivals for contract growers, competing by offering different contract terms, building designs, costs, and payment schedules. Firms also compete for investor capital. For example, cattle feedlots compete for investors to feed cattle in their lot rather than elsewhere. Expanding firms need to attract investment capital and want to be seen as the firm of choice in their sector. Labor and management is another critical input in short supply in a rapidly growing/changing industry. Competition for labor tends to be a local rivalry and includes other industries competing for entry level labor. Managers for production sites are more mobile and are typically hired away from another firm.

Concern about market power of meat and milk processors has spawned numerous Congressional hearings, agency listening sessions and court cases. Research results regarding processors' market power have been mixed. Most published research suggests market power exists in the slaughter cattle and hog markets, but the economic damage due to measured market power has been insignificant. Since processors compete heavily based upon their cost structure, minimizing production costs is critical to profit maximization. The cost structure of meat and milk processing requires consistent, optimal through-put for profit maximization, which makes it difficult for processors to exert market power. In the case of milk, the federal marketing order system also makes it difficult to use market power to processors' advantage. However, consolidation at the retail level is a concern for both producers and processors of meat and milk and it has been a major influence on dairy industry structure. Being big enough to serve a mega-retailer contract requires either a big cooperative or a

federation of cooperatives.

Barriers to Entry

While it is relatively simple to get into livestock production, the entry barriers to produce a meaningful supply can be significant in part because production infrastructure is costly to build or buy. Yet, new entrants may be better financed, organized differently such as being vertically integrated, or have new markets related to foreign ownership or becoming a full line supplier—providing them with a competitive edge over existing competition. Risk of entry by potential competitors is more of a concern at the product level in the form of imports or substitutes which impact livestock and dairy producers. Imported live cattle and hogs are often seen as a threat by U.S. cow-calf operations and feeder pig producers. However, some cattle feedlots and hog finishers see the imported animals as an increased supply of feeder livestock and a profit opportunity. U.S. producers view competitors in export markets as a threat to the demand for their product.

Substitute Products

The risk of substitute products as a force depends on where it is measured, but in general it is a force impacting producers. By the nature of commodity products each unit is a near perfect substitute for the next one. As a result producers are largely price takers. There are increasing attempts to differentiate products based on credence attributes such as “cage-free” eggs or “organic” beef or pork. To date these are relatively small markets, and in some cases these niche producers have used disparaging remarks about conventional production systems to further market their product. At the product level, substitutes are a significant driver of profitability for animal agriculture. Chicken is a lower cost substitute for beef and pork and the poultry industry over the years has been more innovative in product development, branding and industry focus. While there is not a direct substitute for milk, a variety of products including soft drinks, energy drinks and soy milk are substitutes in consumers’ shopping carts.

Technology

Technology is an important force impacting animal agriculture. One measure of productivity in animal agriculture is pounds of meat or milk produced per breeding animal. Although there are other factors that can influence this productivity measure, over long periods of time it provides a reasonable comparison of differing impacts of technology across sectors. And the differences in productivity observed across sectors are striking. In the case of pork, annual pork production per sow in the breeding herd inventory increased 30% just since 2000. This productivity increase is adjusted for increased pig imports and is primarily attributable to improved reproductive performance and increasing carcass weights driven by genetics and management. By comparison, broiler meat per broiler hen increased 25% and milk production per cow increased more than 16% over the same time period. Just as artificial insemination increased genetic potential a generation ago, sexed-semen is expected to push milk productivity up in the future, partly by accelerating genetic improvement and also by increasing the percentage of heifer calves born, which effectively raises total herd production. The hog and milk industries in particular have seen firms more adept at adopting new technology expand at the same time that existing firms are going out of business. In contrast, the beef industry in recent years has focused more on improving product quality and has not benefitted as much from rapid development and adoption of cost reducing production technologies. As a result, commercial beef production per cow — adjusted for live cattle imports—in 2010 changed little compared to a decade earlier, which is in sharp contrast to the large productivity improvements observed elsewhere in the livestock sector.

Other Drivers of Change

“Other Drivers of Change” which include government regulations by the United States and other governments, advocacy by nongovernmental organizations, and shifting consumer preferences, are perhaps the largest forces shaping animal agriculture today. Government regulation and policy that address water quality, air emissions and dust, country of origin labeling, marketing practices, trade restrictions, and renewable fuels that emanate from a variety of government agencies all impact animal agriculture. An example is the Concentrated Animal Feeding Operations (CAFO) rules related to federal water quality requirements, which were revised by EPA in 2003, subsequently challenged in court and revised again. EPA is now moving forward with rules under the Clean Air Act that proposes regulating emissions from livestock facilities, including dust from farming operations and feedlots. While the requirements are not finalized, the proposed changes and ensuing discussion has taken a lot of energy, created tremendous uncertainty in the industry, and has hampered investment.

Country of Origin Labeling (COOL) divided the industry, consumed a lot of industry energy and created uncertainty about which and how meat products were to be labeled in retail stores. We are now more than two years in to implementation of this labeling requirement and, although it is still unclear how beneficial this has been for consumers, it has certainly created more record keeping requirements and raised costs for firms throughout the marketing channel. More recently, proposed changes to marketing practices by USDA-Grain Inspection Packers and Stockyard Administration (GIPSA) has also divided the production sector and may sever relationships between producers and processors that evolved over the last two decades (Ferrell and Rumley, 2011). Marketing agreements designed to address market failures and allow segments of the industry to improve product quality, and reduce supply and price risk, could be prohibited. The result could be a supply channel that is forced to operate at a higher total cost level and reduced investment in the industry.

Exports have become a much more important component of demand for U.S. poultry, pork and beef than they were a decade ago. As such they are more susceptible to trade restricting actions by foreign governments that, in some cases, are unrelated to agriculture. Coupled with animal disease risks—for example, Foot-and-Mouth Disease (FMD) and *Bovine Spongiform Encephalopathy* (BSE)—that can result in restricted or complete loss of access to export markets, has added uncertainty to producer decisions. These “stroke-of-the-pen” risks that impact production costs or demand will continue to shape the livestock sector in the future.

Perhaps the largest recent economic shock to the livestock sector was due in part to the change in the U.S. energy policy that set targets for the use of renewable fuels from 2008-2022. The implementation of these annual Renewable Fuels Standard (RFS) targets, coupled with weather problems in major grain producing countries, resulted in feed grain costs that are significantly higher and more volatile than prior to implementation of the RFS. The change in corn usage attributable to the new standard has been dramatic, with nearly 40% of the U.S. corn crop during the 2010 crop year devoted to ethanol production. Looking ahead, the amount of corn used for ethanol production may soon surpass the amount consumed by animals. This new demand has not only contributed to higher feed costs, it also helped boost feed cost volatility. The result has been an increased exodus from the animal production industries by higher cost firms, thereby accelerating industry consolidation and, ultimately, leading to a smaller industry than otherwise would be the case.

Livestock and poultry production is on the defensive from attacks by NGOs regarding animal care and welfare, the use of sub-therapeutic antibiotics and contributions to green house gas (GHG) emissions. The Humane Society of the United States (HSUS) successfully spearheaded ballot initiatives in California, Arizona and Florida that restrict animal housing practices. HSUS negotiated similar restrictions in Colorado and Michigan and impacted the ballot in Ohio that led to an oversight board for animal housing and care. There has also been a push to restrict the use of sub-therapeutic antibiotics as growth promotants in animal agriculture for fear of contributing to antibiotic resistant pathogens in humans. A 2007 U.N. FAO report attributed 18% of GHG to global animal production. Although EPA estimates the contribution of livestock and poultry at just 2% in the United States, the sector finds itself defending its track record with prospects for mandated change on the horizon. Ultimately, all of these restrictions lead to higher production costs and discourage livestock production in the affected regions.

While some of these external forces, if successful, will drive up production costs and/or favor one production system or region over another, other forces actually seek to eliminate the production of animals for food. And, on some issues, retailers are becoming the new regulators. NGOs have found that retailers with a brand to protect can be influenced through shareholder action or the threat of boycott easier and faster than legislation and regulations can be passed and implemented.

Concluding Comments

Key animal agriculture issues in the years ahead will be:

1. Consumer demand in domestic vs. international markets. Stagnant population growth, and aging of the U.S. population, will make domestic demand growth more difficult to achieve. The focus in the domestic market will be increasing product differentiation to increase market share. Increasing demand and market share in international markets will focus on meeting the needs of consumers in importing countries, which vary significantly around the globe. This will lead to an increase in inter-firm rivalry.
2. Cost competitiveness. Cost competitiveness historically was based on being competitive within the domestic industry. In years ahead, cost competitiveness will focus much more closely on competition across borders.
3. Product differentiation. Niche markets will continue to splinter from mainstream products and

marketing. Rivalries will emerge within these smaller markets as producers vie for retail shelf space and between mainstream production and niche products as they compete for customers.

4. Driving forces—either by regulations, retailer decisions or activist’s movements—will trump economics on some hot button issues.

These key drivers will shape animal agriculture in the years ahead. Consolidation is expected to continue and Porter’s framework will provide insight into how firms behave and the resulting industry structure that evolves. In addition, objective and timely economic analysis of consumer demand, producer costs and proposed policies will be essential to making decisions that foster a viable livestock, dairy and poultry sector.

For More Information

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