

**Food System 21: Gearing Up for the  
New Millennium--The Hog/Pork Sector**

by

Mike Boehlje, Kirk Clark, Chris Hurt  
Don Jones, Alan Miller, Brian Richert  
Wayne Singleton, Allan Schinckel

Staff Paper #97-19

December 1997

**Dept. of Agricultural Economics  
Purdue University**

*Purdue University is committed to the policy that all persons shall have equal access to its programs and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.*

# **FOOD SYSTEM 21: GEARING UP FOR THE NEW MILLENNIUM-- THE HOG/PORK SECTOR**

by

Mike Boehlje, Kirk Clark, Chris Hurt, Don Jones, Alan Miller, Brian Richert, Wayne Singleton,  
and Allan Schinckel

Dept. of Agricultural Economics, Purdue University

West Lafayette, Indiana 47907-1145

boehlje@agecon.purdue.edu

Staff Paper #97-19

December 1997

## Abstract

The U.S. agricultural production and food distribution industry is currently in the midst of major structural changes. To assist in understanding the implications of these changes and the future of the industry, faculty in the School of Agriculture at Purdue University in collaboration with industry representatives undertook a study to assess the future of the food production, processing and distribution system. The results of this analysis are reported in detail in "Food System 21: Gearing Up for the New Millennium". This publication is one chapter of that book. It discusses the future challenges and opportunities in the U.S. hog/pork sector and the type of industry that is expected to evolve. For a copy of the entire Food System 21 study, contact:

Agricultural Communication Service

Media Distribution Center

301 South 2<sup>nd</sup> Street

Lafayette, Indiana 47901-1232

1-888-EXT-INFO

FAX (765)496-1540

Keywords: hog/pork industry, pork demand, pork supply chains, industrialization of pork production.

Copyright © by Mike Boehlje. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

# FOOD SYSTEM 21: GEARING UP FOR THE NEW MILLENNIUM-- THE HOG/PORK SECTOR

by

Mike Boehlje, Kirk Clark, Chris Hurt, Don Jones, Alan Miller, Brian Richert, Wayne Singleton,  
and Allan Schinckel

## Introduction

The U.S. pork industry is in the midst of major structural change—changes in product characteristics, in worldwide production and consumption, in technology, in size of operation, in geographic location. And the pace of change seems to be increasing. Pork production is changing from an industry dominated by family-based, small-scale, relatively independent firms to one of larger firms that are more tightly aligned across the production and distribution chain. The location of the industry is shifting from the traditional production regions of the Midwest to other locales in the U.S. and the world. The industry is becoming more industrialized, more specialized, more managerially intense. The causes of these trends and their impact in the first decade of the 21st century is the focus of this discussion.

## Background

### Production

Domestic pork production has increased sharply since the mid-1980s. It reached a high in 1980 after a major build-up of production capacity in the late 1970s stimulated by high farm incomes, by new investments in confinement building technology, by investment tax credit incentives, and by

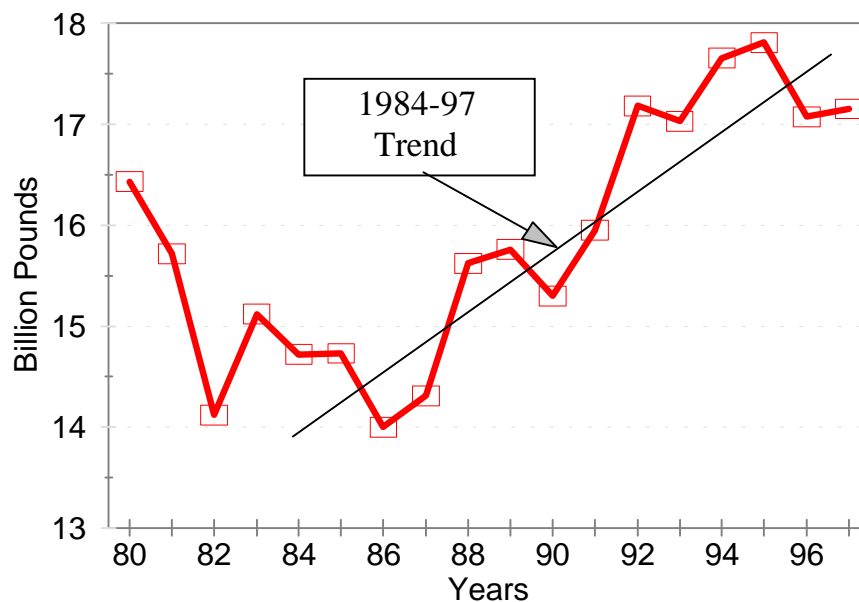


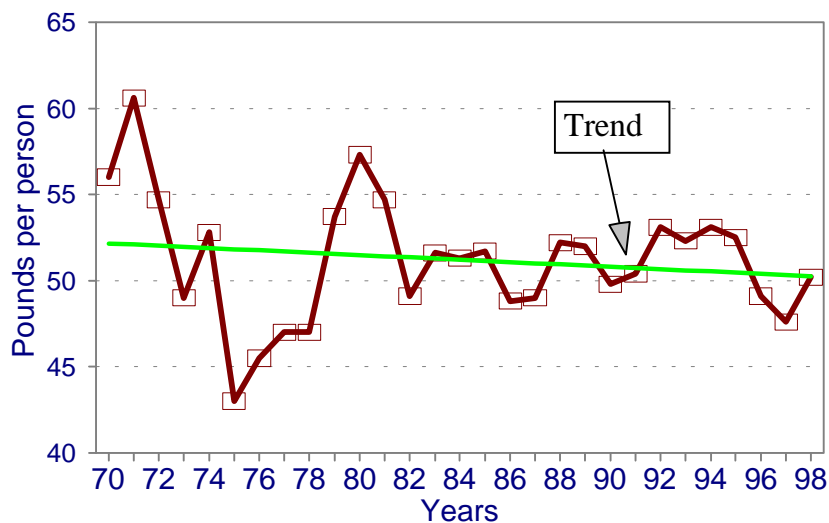
Figure 1. *Commercial Pork Production*

anticipation of continued increases in hog prices. Production peaked in 1980 at about 16.5 billion pounds, a level which was not exceeded until 1992.

The rate of annual growth in U.S. pork production has been somewhere between 1.2 percent and 2 percent, depending upon which beginning year is considered, as shown in Figure 1. Measuring from 1984 to 1997, the annual growth rate has averaged about 2 percent, exceeding the growth rates of the 1960s and 1970s. The increased rate has largely been due to changes in trade, where exports have increased and imports dropped.

### **Demand and Consumption**

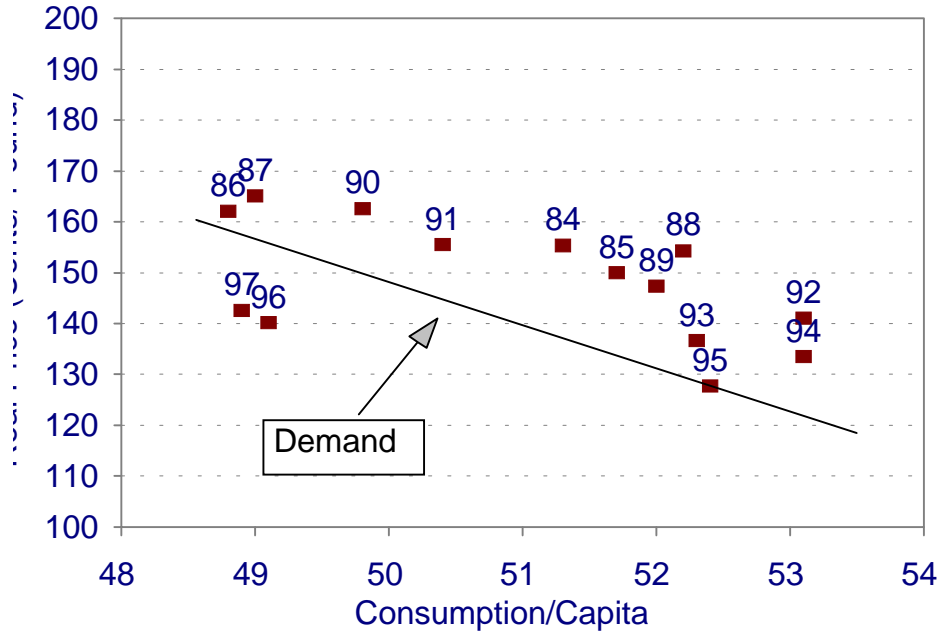
While pork production has increased at around 2 percent per year over the past decade, most of the growth in consumption has come from increases in U.S. population and from changes in trade balances, rather than from enhanced demand. Figure 2 illustrates per capita consumption in the U.S., the trend line showing a slight erosion over time. While the long-term trend has been a slight decline, since 1984 the trend is nearly flat.



**Figure 2. Per Capita Pork Consumption (Retail Weight)**

Per capita consumption has been relatively stable since the early 1980s, which is in sharp contrast to the wide swings experienced in the 1970s, when per capita consumption varied from 43 to 61 pounds. Since 1982, per capita consumption has averaged between 48 and 53 pounds.

A second measure of demand is shown in Figure 3 and is represented by plotting the level of per capita consumption against inflation adjusted retail prices (real prices). This provides a rough proxy for domestic pork demand. As expected, when production per capita is high, retail prices are

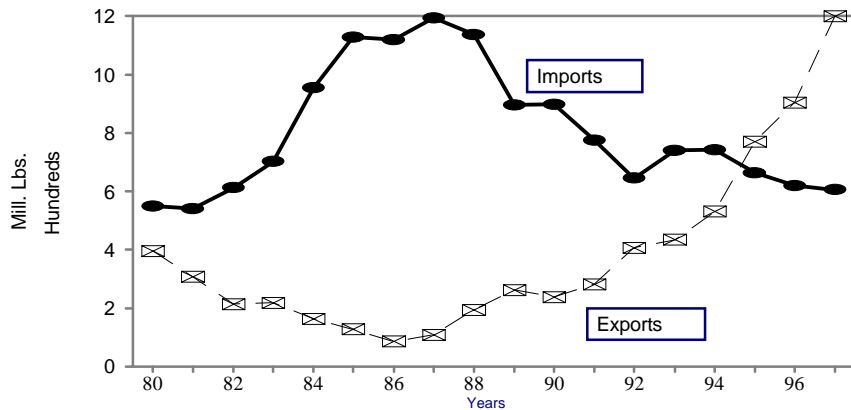


**Figure 3. Real Retail Price: Pork Consumption (Deflated by CPI: 1982-1984=100)**

low. The plotting is for various years from 1984 through 1997. Note that the plotted years are clustered fairly close to the trend line, indicating domestic demand may be staying fairly steady.

Since total domestic consumption has increased with a fairly stable per capita consumption, this means the primary source of domestic demand growth is due to rising population. Population growth has averaged a little over 1 percent annually since 1984 and is the primary driver of increased domestic pork consumption.

The remaining portion of the growth for U.S. pork production is due to changes in trade



**Figure 4. U.S. Pork Trade**

balances. As shown in Figure 4, the U.S. was a large net importer of pork in the mid-1980s. This was largely a result of huge imports of live hogs from Canada, trade barriers around the world, a strong U.S. dollar, and a lack of interest by the U.S. industry in exporting pork. In 1985, 1986, and 1987, for example, imports exceed exports by over one billion pounds annually. In 1997, exports are expected to exceed imports by about 600 million pounds, with exports surging to 1.2 billion pounds.

Figure 5 illustrates the two components causing the need for added pork production since 1984. In 1997, about one billion pounds of additional pork will be utilized in the domestic market as compared to 1984. Trade will require an additional production of about 1.5 billion pounds compared to 1984 because of both lower imports and higher exports.



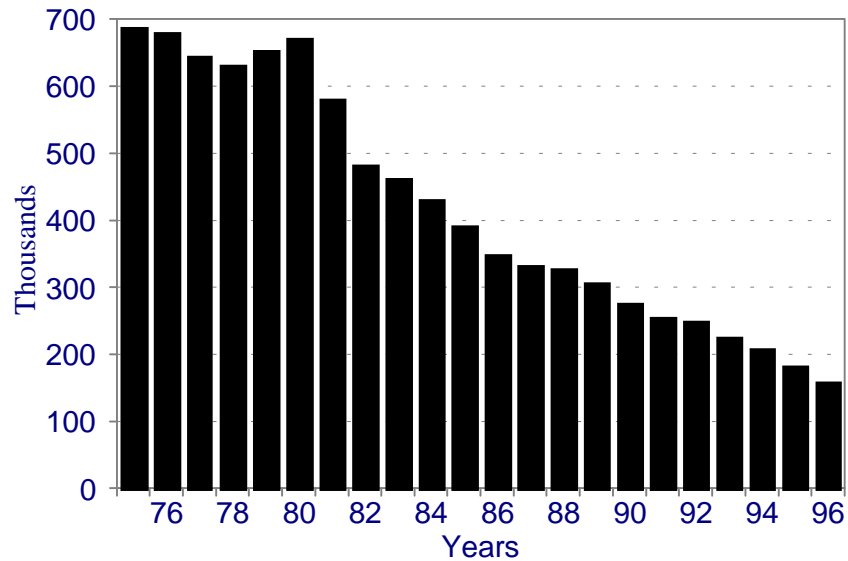
**Figure 5. Production Change Since 1984 Due to Domestic Growth and Trade**

Thus, trade has been very important to the growth in domestic production over the past decade. The 2-percent annual growth rate in production is composed of about 1.1 percent supplying the domestic market and .9 percent from trade. It is also interesting to note how steadily the growth in trade has been since the late 1980s (Figure 5). While increases in domestic consumption in the past have been a greater enhancement to production growth, trade now may exceed the domestic market as a source of growth potential.

### Production Structure

The number of farms with hogs continues to decline sharply. This trend has been evident since the 1950s, but the rate of outmigration has accelerated since 1980 (Figure 6). By 1996, only 157,450 farm operations had hogs (USDA). This represents a startling decrease of 77 percent since 1980.

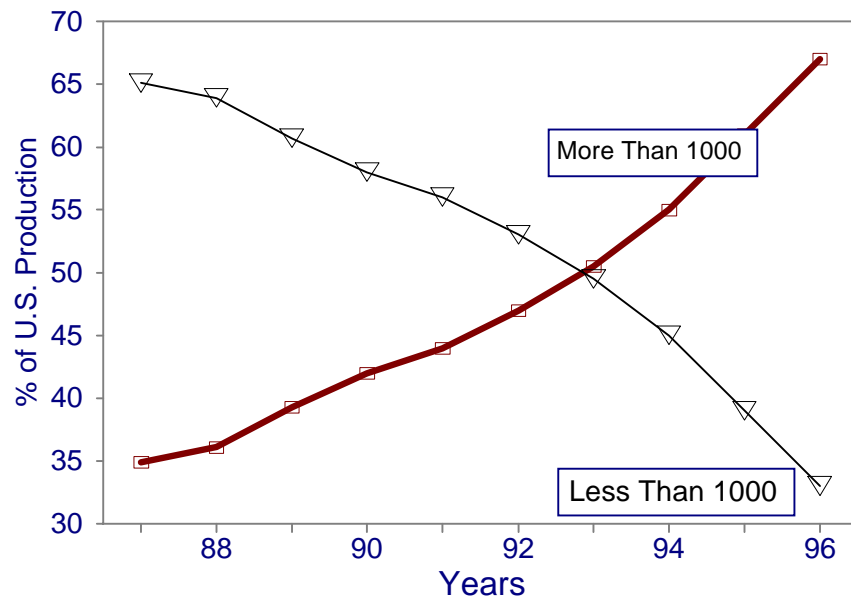
Thus, for every four farms with hogs in 1980, three have left hog production.



**Figure 6. Farmers with Hogs (December 1: USDA)**

USDA reports that 24,300 fewer farms had hogs at the end of 1996 compared to the start of the year. Of the farms leaving the industry, 12,000, or about 50 percent, represented operations which had an inventory of less than 100 head. About 9,000 of the farms leaving had an inventory of 100 to 499 head, and 2,400 had an inventory of 500 to 999 head. For the first time ever, farms with 1,000 to 1,999 head had a decrease in 1996 totaling 670 farms. The number of farms with 2,000 head or more grew by 80 farms in 1996. The number of farms with under 1,000 head of inventory is declining rapidly, as is their portion of total inventory. In 1987, farms with under 1,000 head of inventory accounted for about two-thirds of the U.S. inventory; in 1996 that was about one-third (Figure 7).

As in 1996, the long-run trend is for the smaller farms to leave the industry. Since 1980 the average outmigration of hog farms has been near 5 percent per year. However, in 1995 and 1996, the annual loss was at a double-digit rate due to very low hog prices in 1995 and extremely high corn prices in 1996. In these two years combined, about 25 percent of the farms quit hog production.



**Figure 7. Percent of Hog Inventory in the U.S. (Less and More than 1000 Head: USDA)**

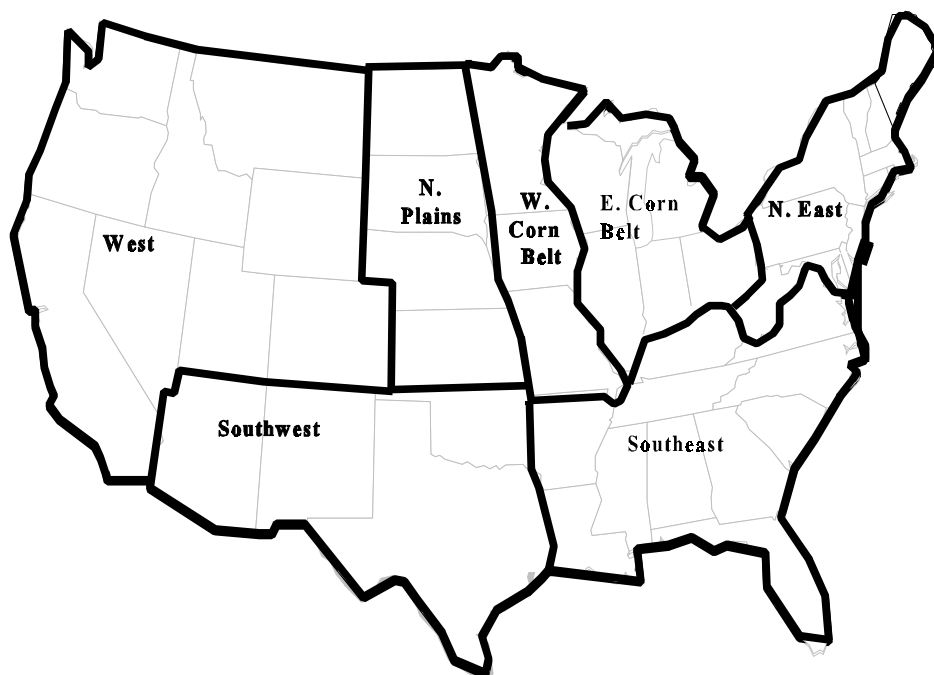
What types of farms are leaving the industry, and which farms are most vulnerable to outmigration? Again no survey data are available. But such farms as the following are believed to be susceptible to outmigration: smaller farms; high-costs farms; diversified single-manager operations; farms with dated technology; farms where the manager is approaching retirement age; and farms where there is no one to take over the operation.

A number of major Midwestern states still have around half of their hog inventory on farms with less than 1,000 head and thus may have more vulnerable industries. These states and the percentage of inventory on farms with less than 1,000 head are: Iowa, 46 percent; Nebraska, 46 percent; Wisconsin, 55 percent; South Dakota, 58 percent; and Ohio, 61 percent. Illinois has 38 percent and Indiana has 36 percent of their hogs on farms with less than 1,000 head.

### **Production Location**

The Midwest has long been the dominant region of production, and that continues to be the case. Measures used here to provide a view of pork production by state are the liveweight marketings of each state as reported annually by USDA. Data for 1996 and 1997 are not yet available, so estimates for those years are based upon the size of the breeding and market herds in each state at the beginning of each year. The regions of the country are shown in Figure 8, with data in Table 1.





**Figure 8. Pork Production Regions of the United States**

**Table 1. Liveweight Marketing of Hogs: Percent of U.S. by Region**

Region	1980	1985	1990	1991	1992	1993	1994	1995	1996e	1997e
N. East	1.7	2.0	2.2	1.9	1.9	2.1	2.0	1.7	1.6	1.5
S. East	15.7	13.4	15.2	15.1	15.8	16.5	17.6	19.4	21.3	23.1
E. Corn Belt	25.8	27.2	26.6	26.4	25.3	25.2	23.7	23.0	21.2	19.9
W. Corn Belt	39.5	41.6	38.3	38.3	39.2	38.5	39.1	38.4	38.3	37.0
N. Plains	13.3	12.8	14.5	14.8	14.3	13.9	13.4	12.6	11.6	11.1
S. West	2.1	1.6	1.6	1.6	1.5	1.8	2.1	2.9	3.9	5.0
West	1.9	1.4	1.6	1.8	1.9	2.0	2.1	2.0	2.1	2.4
Sum	100	100	100	100	100	100	100	100	100	100
12 N.C. States	78.6	81.6	79.3	79.5	78.8	77.6	76.2	74.0	71.1	67.9

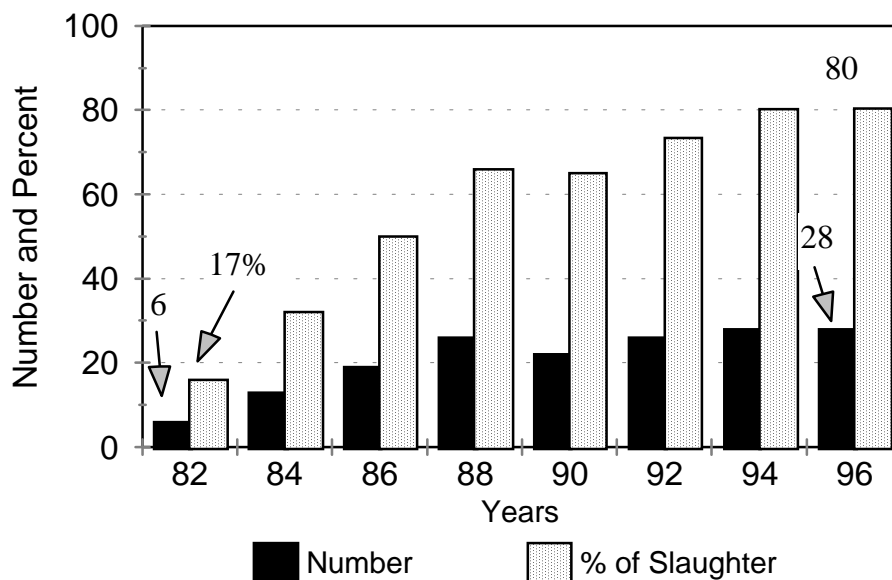
*e=estimates for 1996 and 1997*

The Midwest is a region of vast but declining importance in national production. At the peak in 1985, the 12 “North Central” states (Eastern Corn Belt, Western Corn Belt, and Northern Plains) marketed about 82 percent of the nation’s liveweight of hogs; this will erode to an estimated 68 percent for 1997.

While the Midwest has declined recently in relative share of hog production, other regions are growing dramatically. This growth is dominated by the Southeast, where national market share has grown from 13 percent in 1985 to 23 percent estimated for 1997. The growth in the Southeast is all due to expansion in North Carolina, since other Southeast states have actually experienced declines in production. The secondary regions of rapid growth have been in the Southwest, where growth has increased from 1.5 percent in 1985 to near 2.5 percent for 1997, and the West, where the growth rate has increased from 1.5 percent to 5 percent over the same period. Combining the growth regions of the Southeast, Southwest, and West, their share of national marketings has increased from 16 percent in 1985 to 31 percent estimated for 1997, offsetting the declining relative share in the North Central states.

### **Processing Structure**

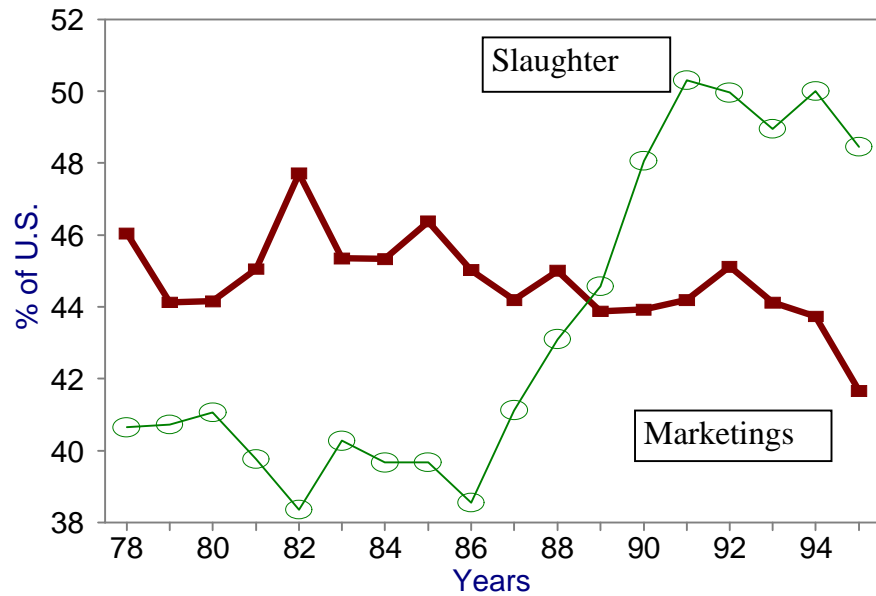
In 1996, 10 pork processing plants had over 3 million head of annual capacity and processed about 42 percent of the hogs. Perhaps an even more startling statistic is that the largest 28 plant locations (those with 1.5 million head of capacity or more) processed 80 percent of the hogs. As shown in Figure 9, the shift to much larger plants occurred rapidly in the past decade. In 1982, only six plants exceeded 1.5 million head of processing per year, and they accounted for only 17 percent of processing.



**Figure 9. Number of Pork Plants over 1.5 Million and Percent of Total Slaughter**

In the late 1990s, the standard scale of plant is around 8,000 head per daily shift. These plants are expected to be double shifted, thus running 16,000 head per day, or 4 million head per year. The largest plant is double this size, or 8 million head per year. New plants are expected to be built at a minimum scale of 4 million head per year. If all plants were at a scale of 4 million head, this would require only 24 total plant locations to process U.S. hog production.

With relative production declines in the North Central region, the estimated slaughter capacity now exceeds production. Estimated 1997 slaughter capacity in the region is 71 percent of the national total, while production is estimated at 68 percent. This is illustrated by the marketings and slaughter in Iowa, Illinois, and Minnesota. A major expansion in slaughter capacity, particularly in Iowa in the late 1980s, in combination with declining production makes this area the largest importer of animals for processing. In 1995, imports to this area represented about 6.5 million head of hogs that had to be transported from other areas (Figure 10). Hog prices are higher in this region as a natural consequence of the excess demand for processing. Cheap corn and high hog prices make this an attractive area for hog production, especially the western regions of Iowa and Minnesota.



**Figure 10. Iowa, Minnesota, Illinois Marketings and Slaughter**

Estimated processing capacities for 1997 are shown in Table 2. These estimates reveal the firms behind the increased concentration discussed earlier. In 1997, Smithfield Foods and IBP are expected to be the two largest processors and are nearly the same size. These two firms represent nearly 40 percent of the national industry. The largest six firms are all multiplant operations and have the capacity to process 72 percent of the nation’s hogs in their 24 plants. The largest 10 operations shown in Table 2 have an estimated capacity of 84 percent of the industry, leaving only 16 percent of capacity accounted for by all other processors.

**Table 2. Estimated Daily Slaughtering Capacity of Largest 10 Processors: 1997**

Rank	Name	Number of Plants	Daily Capacity (1,000 head)
1	Smithfield Foods	5	80.3
2	IBP	7	79.9
3	Swift	3	39.4
4	Cargill/Excell	3	37.8
5	Hormel/Rochelle	3	34.7
6	Farmland	3	22.8
7	Seaboard	1	15.0
8	ThornApple Valley	1	14.0
9	Indiana Packers	1	13.0
10	Lundy's	1	8.0
	Sum of Largest 10		344.9
	Approximate National Capacity		411.8

*Source: Steve Meyer, National Pork Producers Council, 1996, Pork Industry Economic Review*

Pork processing in the 1970s and 1980s was characterized by excess capacity, with older plants in the Eastern U.S. being closed as plants in the Western Corn Belt opened. Mergers, acquisitions, and consolidations were standard business practices. In the 1990s new trends have evolved as old ones continue. Excess capacity and consolidations continue. New trends have included the shifting location of slaughtering and the surprising birth of a number of new entrants to the industry. Old packing capacity in the East and Eastern Corn Belt finally declined sufficiently, and new plants have been built in the 1990s. Another trend is the movement of slaughter capacity (and production) to regions outside the traditional North Central region, such as the Smithfield plant in North Carolina.

While much of the industry was closing plants and consolidating, the 1990s have found several new entrants opening single plants. These included Indiana Packers Company, Premium Standard Farms in Missouri, and Seaboard Farms in Oklahoma. These plants are based upon highly coordinated raw material flows, increased emphasis on pork quality, and the pursuit of closer alliances with their pork clients to add greater value to pork products, including high quality, specific attribute meats, special products, and unique services. These plants have moved away from a commodity orientation because they are not able to compete purely on a high-volume and low-cost basis with some of the larger multiplant firms, and have embraced a value-adding differentiated product philosophy.

## **U.S. in the Global Economy**

The vast majority of the world's pork is consumed in the country where it is produced. In 1994, pork exports only represented 7 percent of total world production. If inter-country transfers within the European Community are not considered, then only 3 percent of production moves in international trade. The United States has not been a major player in the export market for pork in the past. In 1994, for example, the United States ranked seventh among the countries in total pork exports. In that year, our imports still exceeded exports. But our limited emphasis on the export market is changing. By 1997, our rank is expected to move to fifth, after Denmark, the Netherlands, France, and Belgium. Pork exports have more than doubled since 1994 (Figure 4).

Although, historically, little pork has traded internationally, this is changing rapidly. There are important differences in the costs of production, with the U.S. being the lowest cost relative to European and Asian competitors. However, the world's largest exporters, such as Denmark, the Netherlands, and Belgium, have not been low-cost producers. In fact, low-cost production has not been a necessary nor a sufficient condition for success in world markets. Thus, exports have historically been driven by factors other than low costs in live hog production, such as quality and product adaptation. The opportunity to expand exports in the future will be enhanced by a reduction in the worldwide attitude of self-sufficiency, by adapting pork products to individual country taste, by rigorous quality control programs, and by superior health and sanitation standards. With greater globalization, the advantages of the U.S. industry being a low-cost producer, processor, and transporter will become increasingly important.

While there is great diversity in the way pork is produced around the world, there are also a set of common trends that will impose more commonality in the future.

- Environmental concerns in production are nearly universal.
- Many countries are experiencing major structural changes (similar to that in the U.S.) in their production sectors.
- While technology is diverse, the most efficient farms in different countries use similar technology.
- The trend is toward a "World Standard" as there is greater commonality of technology, size of production units, pork processing, and pork quality.

## **Drivers and Direction of Change**

### **Consumer Demand**

Consumers will be a primary driving force directing the future of the pork industry. The past decade has seen pork maintain its market share in the domestic market, but the share has not increased. Pork will have to have a better track record in the next decade if it is going to gain favor with the domestic consumer. To increase market share, the pork industry will need to lower prices in relationship to beef and poultry, as well as become more innovative and move more rapidly toward new consumer products.

In trade, the opening of markets under GATT and NAFTA will continue to provide opportunity for growth. Trade will become an increasingly important aspect of our markets in determining the financial returns to the sector. Rapidly rising incomes in Asia will likely provide the

strongest stimulus to foreign pork demand. Changing trade patterns in Europe will likely mean more regional specialization in pork production and greater trade within the community, but less emphasis on exporting pork outside the community. This may provide an opportunity for increased market share for U.S. pork in the Asian market. Income growth in Mexico should also be an important stimulus to added exports to that country.

Increased reliance on trade will add greater instability to the U.S. markets. Fluctuations in the dollar, trade disputes, concerns over drug use or sanitation, in addition to the unforeseen events of weather and politics in far-off countries will now more greatly affect the pork industry in the U.S. While destabilization is a cost of greater reliance on the export market, growth is the benefit as trade is expected to provide near one-half of pork's growth potential in coming years.

### **Technology/Productivity**

New technology has been a major force for change in the sector in the past, but technological change has accelerated in the past decade. And changes in coming years will be no less dramatic.

### **Nutrition**

Changes in swine nutrition will focus on feeding regimes based upon the specific needs of the animal during specific growth phases. There will be increased utilization of phase and split-sex feeding, with four diets during the nursery phase and five more diets per sex to market weights. Expect separate gestating and lactating gilt and sow diets, as well as gilt development and boar stud diets. The use of all these diets will net the producer another \$0.75-1.50 per hundredweight (/cwt.) for phase feeding and \$0.75/cwt. for split-sex feeding. An additional benefit to phase feeding is a 15-percent reduction in nitrogen and phosphorous excretion.

The use of by-products in diets will become more commonplace in the Midwest, as it is in many parts of the world. By-products will be contracted for long-term inclusion in diets, compared to the current use of by-products as an emergency substitution for high-priced corn. Making a long-term commitment to use by-products in diet formulation will be a direct result of an increasing percentage of producers not being self-sufficient in grain production. In addition, more volatility in grain prices will mean a greater opportunity for by-products as economical energy or protein sources.

Environmental stewardship and government regulations will encourage producers to improve manure nutrient management. The use of synthetic amino acids will continue to grow in an effort to reduce nitrogen and ammonia concentrations in manure and odor from swine facilities. Reductions in phosphorous excretion will also be enhanced by the use of microbial phytase to increase the phosphorous availability in all plant protein and energy sources. The practice of including 500 phytase units per ton of grow-finish feed and lowering the total dietary phosphorous level by .1 percent to .3 percent will reduce phosphorous excretion by 30 percent to 50 percent. A 50-percent reduction in excreted P by pigs would mean that most Midwest pork producers would not need additional land above that required for manure application based on manure N concentration. This could have a major impact in the Midwest and would especially be significant as environmental regulations are being proposed to regulate swine waste application on a P basis.

## **Health**

The health status of pigs during the last half of the 20th century was closely related to the availability of antibiotics to treat and control diseases, and to vaccines to prevent the clinical expression of diseases. From 1955 to the present, cesarean section of pigs has provided specific pathogen-free pigs. This technology had only a minor impact on the industry because “disease-free” herds over time became diseased. During the past 15 years, a series of health-enhancing technologies have been developed in the form of medicated early weaning, all in-all out rearing, and now segregated early weaning. These technologies, along with better nutrition and facilities, have led to the production of High Health Status (HHS) pigs.

Although the production of HHS pigs is still in its infancy, their enhanced performance already provides significant competitive advantage to standard rearing technologies. This competitive advantage will result in wide-spread implementation of HHS rearing of pigs in the 21st century. Implementation of this new technology is not without additional costs in reproductive performance, management and facility changes, and presentation of new disease complexes in the porcine respiratory disease complex. However, with all these costs included, the new technologies are cost lowering. Much is still to be learned, including implementing the technology across small scale operations, tightening biosecurity, reducing dependence on antibiotics, reduction of re-breeding problems in sows, and consistently improving performance to sustain a competitive advantage.

## **Breeding/Genetics**

Commercial producers will increasingly implement terminal crossbreeding systems which utilize crosses of specialized sire and dam lines. Genetic selection will be based on a combination of expected progeny deviations and genetic markers. Maternal lines will be selected on reproductive and postweaning traits. Genetic improvement will result in a one and one-half to two pig per litter increase in number born alive in the next decade.

Terminal sire lines will be selected for postweaning traits, including growth rate, lean growth rate, increased carcass leanness, and improved pork quality. Genetic selection will be based upon lean growth to maximize daily profits.

Different sire lines will be developed for different health status levels as well as different markets. Extremely lean low-feed-intake terminal sire lines, which produce pigs found to be more responsive to environmental factors, will be targeted towards HHS pigs in three-site production. Lines with moderate feed intakes will be targeted towards commercial units that have average health status. Within five years, at least two types of sire lines will be developed for different markets. One sire line will be selected to produce extremely lean and efficient pigs, with an objective of least-cost for reasonably acceptable lean pork. Other lines, destined for export and restaurant markets, will be selected for high pork quality. These lines will be darker in color and contain approximately 3 percent intramuscular fat.

Commercial producers will strive to efficiently manage terminal crossbreeding systems. They will carefully evaluate alternative gilt multiplication programs, including grandparent and great-grandparent programs. Groups of smaller producers will form cooperative multiplier herds.

Commercial producers will use only the very highest maternal sires via artificial insemination. Management targets, including age of first breeding, weight, composition at breeding, and nutrient intakes will be developed for each genetic source of gilts to increase productivity and longevity.

### **Reproductive Management**

Use of artificial insemination (AI) technology has increased from less than 1 percent in the early 1990s to an estimated 30 percent today. By the year 2000, it is likely that AI will account for over 50 percent of production. Since an AI boar can sire over 4,000 pigs per year as compared to about 400 by natural service, three important implications result: (1) well over one-half of the nation's pig production can be sired by "elite genetic" sires, which will result in a \$6 to \$10 per head economic advantage over average genetic sires; (2) significant changes in the structure of the seedstock industry will be necessary, because there will be a high demand for superior-elite sires and low demand for average sires; and (3) the number of sires required by the industry will be sharply reduced.

Breeding facility designs will improve to accommodate the use of AI. Use of AI has and will continue to spawn a whole new industry. Producers will have access to new and different genetics on almost a daily basis. New companies will be formed to provide semen, supplies, and training programs. Commercial producers will redesign facilities to accommodate AI use and reduce current housing allocations for boars.

New technologies will likely be developed to reduce the number of sperm per dose to achieve high reproductive performance. This will further the use of superior boars, reduce the boar inventory, and improve efficiency. New estrus synchronization products may be approved which will allow for more precise control of the timing of matings, especially for gilts.

With the increased implementation of terminal crossbreeding systems, there will be increased demand for specialized terminal and maternal AI sires. Commercial producers will identify and pay premium prices per dose of maternal semen, because very few maternal sires will be superior for sow productivity and post-weaning performance traits combined with multi-generation genetic multiplication of maternal sires. The terminal sire AI market will focus on sires superior in post-weaning performance, carcass leanness, and pork quality. There will be intense competition to produce and transport terminal sire semen as economically as possible. This change in the technology for obtaining genetic material will dramatically alter and challenge the current seedstock industry and, at the same time, provide new business opportunities for those who can cost-effectively provide high-quality genetic material and support services for the AI market.

### **Building/Equipment/Waste Handling**

Housing and environment technologies that will drive change in the next decade include:

- 1) improvements in odor-reducing treatments,
- 2) improvements in dust control,
- 3) improvements in ventilation controls and air distribution, and
- 4) improvements in treatment and stabilization of animal manure.

Dust and odor mitigation technology will improve to the point that, except in rare cases, large swine operations will have no more negative impact on surrounding areas than most other industries.



These control technologies will increase operating costs and thus favor larger operations because of economies of scale. These treatments will improve air quality both inside the building and in the surrounding area. The use of air flow sensors to monitor airflow throughput will become commonplace.

Research is expected to confirm detrimental effects of poor air quality on animal performance and on worker and animal health. These findings will provide the incentive to search for ways to improve inside air quality. Improvement will come through continued improvement in air handling and controls, with source control of contaminants, and with more reliable, economical air cleaning equipment. Improved sensors will become available to enable better control and monitoring of the animal environment in response to climatic changes and to animal growth and activity. Remote monitoring of environmental conditions within buildings will become more reliable and affordable, helping to minimize the risk of failure of the air supply and control system. Environmental control systems will become more integrated, usually designed and purchased as a turnkey system from the same company.

Advances in the physical, chemical, and biological treatment of organic wastes will become feasible for very large operations. There are many countries in the world, particularly in Europe, which do not have sufficient land to safely apply animal manures in their raw form. Developments in Europe and the U.S. will progress to the point that treatment is a practical means of reducing the volume, nutrient concentration, odor, and water pollution potential of animal manures.

Buildings will become more modular in nature, with segments of buildings constructed in central plants and transported to the site. This will take the form more of smaller pre-assembled components (wall sections, etc.) rather than entire pre-fabricated rooms. Construction materials will include more plastics and metal framing as construction quality wood becomes more scarce and expensive.

## **Resources**

### **Personnel**

The cost and availability of labor can have a significant impact on the structure and location of pork production and processing, as well as on the efficiency of individual farms. In a long-run context, labor is relatively mobile and can move among firms and regions if the financial rewards provide incentives to do so. Likewise, demands for higher skill levels can be met by attracting more highly trained employees or providing in-company training, but will result in higher labor costs unless increased labor productivity offsets higher wages and benefits. The skills required in both production and processing are increasing, and the industry will face higher wage and benefit costs, periodic shortages of skilled employees, and recurring training costs. In contrast to the past, the swine industry will be entering into and sourcing from the mainstream of the labor market. This especially is a change for the production sector.

Swine producers in particular are concerned about future labor cost and availability. A recent survey of swine producers and employees identified a number of these concerns. Over 83 percent of the production unit managers indicated they were either satisfied or very satisfied with their jobs

compared to 73 percent of assistant managers and 76 percent of herdsmen. The top three responses that employees indicated would make their jobs more appealing were salary, better communication, and benefit packages. Almost 80 percent of the respondents felt that their salary and benefits were competitive with other job opportunities in their community. Employees working for operations using employee handbooks, written job descriptions, written work plans, and formal evaluations were, on average, about 10 percentage points more likely to be very satisfied with their jobs.

Employees generally felt that their jobs were good training to prepare for advancement or for ownership of their own operations. Almost 70 percent intended to make a lifelong career in pork production, with slightly over half of the employees indicating that a goal was to own their operations someday.

The employee's physical work environment also has a major impact on the level of employee job satisfaction. Over 95 percent of the surveyed employees who rated their working environments as excellent were at least satisfied with their jobs; 71 percent were very satisfied. Over 85 percent of the employees who rated dust or gas levels in their facilities as "low" also indicated they were satisfied with their jobs; about one-half were very satisfied. In contrast, only 10 percent of those in high gas level facilities were very satisfied.

These data and observations suggest a labor market for the pork production industry in transition from an "agricultural" market to an "industrialized" market. Employees will become increasingly skilled and better rewarded. They will have a safer and more healthy work environment. They will consider the pork industry as a long-term career opportunity or as an excellent training ground to develop production and managerial skills that will be useful in managing their own operations. Compensation and benefit cost per employee will rise, but labor productivity is not likely to increase sufficiently to offset these higher costs. Thus, labor costs per unit of output will likely continue to increase. Periodic complaints concerning labor availability and inadequately skilled employees will continue to occur. Those who recognize and use modern personnel management principles in hiring, motivating, and rewarding their employees will be the most successful in solving the perennial problem of "getting good help."

Labor is the largest single cost factor for processors, accounting for 30 to 40 percent of costs. Labor availability has become an increasingly important issue in location of processing plants and in providing the ability to operate at capacity. Availability of labor is particularly a problem due to difficult working conditions and generally modest wage rates. The labor problem for packers can be solved partially by increasing wages to draw more workers from other jobs. However, competition and tight profit margins do not allow them to do this and remain profitable. Only when processors find ways to extract greater values from their pork products, or when all packers raise wage rates, can individual processors feel comfortable in solving the labor problem with higher wages.

### **Capital/Finance**

Access to financing to modernize and expand swine production and processing capacity may present problems for individual firms, but generally the capital markets are relatively efficient in allocating funds to those generating the highest returns. This generalization is more accurate in its application to the processing, wholesaling, and retailing segments of the pork chain than to the

smaller firms in the production sector. Production units that do not use modern technology, that are smaller scale, have relatively high costs, and that have not used accepted tools and techniques to manage operating risks may encounter difficulty accessing financing at reasonable costs.

Lenders are increasingly hesitant to finance pork producers who do not use, or do not understand, the full spectrum of risk management tools available to them, including hedging, contracting, forward pricing of feed and other ingredients, using a consulting veterinarian, and other methods of reducing production and price risk. Analytical studies are increasingly verifying anecdotal evidence that even Midwestern lenders are willing to extend more credit for expansion at lower interest rates to contract growers compared to independent producers with the same collateral base. Thus lenders recognize that more leverage and higher financial risk can be accepted only if operating risk is reduced. This will encourage pork producers to more seriously consider risk-reduction strategies. These pressures from the providers of capital will reinforce other incentives for more explicit vertical linkages and alliances among the various stages of the pork chain.

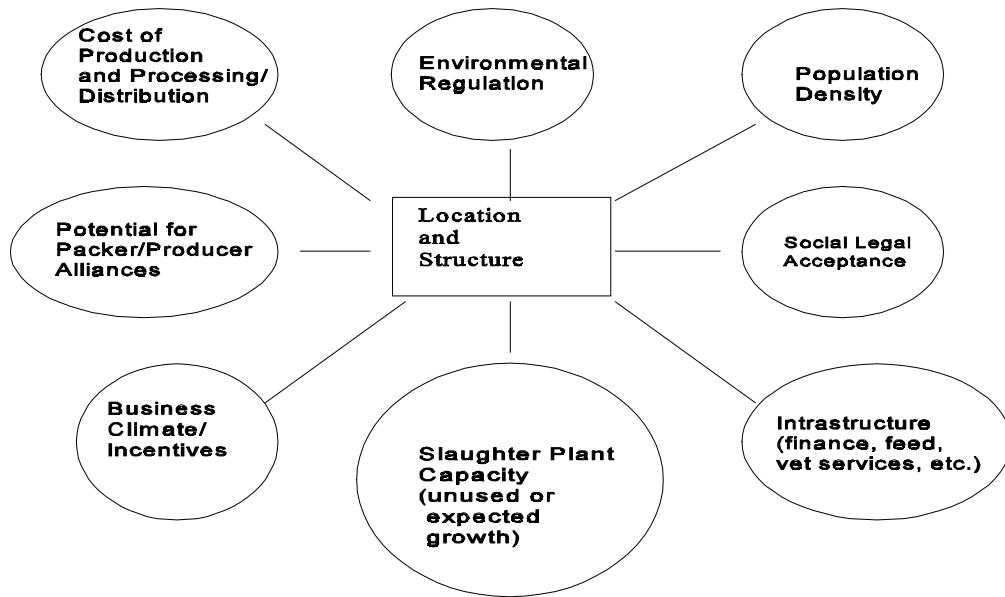
### **Infrastructure**

The significance of support industries on cost and competitive position for a firm and a region should not be ignored; for example, an aggressive and supportive lending and financing infrastructure can be a major determinant of the growth and development of the pork industry. Likewise, service industry firms such as feed companies and veterinary services organizations can play critical leadership roles in facilitating the adoption of new technology and encouraging the development of networks and other business alliances and organizational structures to improve efficiency, lower cost, and increase responsiveness in producing specific products.

But infrastructure, like many resources in agriculture today, is less geographically bound and thus can move from location to location if the proper incentives exist. In the case of larger scale operations, the infrastructure to support the pork production, processing, and distribution activity typically is developed as part of an integrated package. Infrastructure is critical to the long-term success of any industry, but over time that infrastructure can be built in a particular area or region if it does not exist. And building the infrastructure as part of an integrated pork production-distribution system may actually result in a more efficient and more responsive support system for modern day agriculture than attempting to revise or revamp a system that currently exists.

## Structure/Location

A basic question being regularly asked by those in the industry is: where will the next phase of expansion occur? The major determinants of the geographic location and structure of the pork industry are identified in Figure 11. The availability of low-cost resources is always a potential driver of location of any industry. Feed remains the dominant cost component, accounting for 60 to 70 percent of the costs of hog production. However, as whole-herd feed efficiencies decline, the advantage to locate near low-cost feedstuff suppliers is reduced. In addition, multiple-site production enables each phase to be located where it can maximize value to the system.



**Figure 11. Determinants of Pork Industry Location and Structure**

Although cost of production is an important determinant of regional competitiveness, increased resource mobility and reduced transportation and other relocation costs have resulted in narrower cost differentials between geographic regions. In essence the playing field is more level with respect to cost comparisons between regions than it has been in the past, meaning that other drivers or determinants of regional location have increased in relative significance. For example, environmental regulations, population density, and social/legal acceptance of large-scale hog production systems are more important in determining where a facility will be sited compared to 20 years ago. Infrastructure support in the form of veterinary services, feed services, building and equipment construction companies, etc., will be important in the short-run for industry location, but these support industries are again relatively mobile and can move to where pork is produced.

Maximizing slaughter plant capacity by double- or triple-shifting, along with the opportunity to develop strategic alliances between packers and producers to improve flow scheduling, guarantee supplies, and reduce price or quantity risk, may be the most significant determinants of geographic location in the near future. For example, some slaughter plants in the Eastern Corn Belt could be double shifted, increasing slaughter capacity and the opportunity for processing pork in that region substantially. New processing and production plant capacity may be sited in the Southwest or West

because of the opportunities to develop strategic alliances between packers and producers, a business climate that includes tax and other incentives for location of livestock production-processing systems, and less restrictive environmental rules and regulations.

### **Government Policy/Regulation**

Government policies and regulations will shape the hog/pork industry because they impact cost, location, and comparative advantage with other animal product producers.

### **Environmental Regulation**

Environmental regulation encompasses a wide range of issues and concerns important to various members of our citizenry. But, clearly, air quality (odors) and water quality are the dominant concerns with respect to pork production at the current time. Many states have, or are in the process of, reexamining current regulations. In general, regulations are being changed to require greater setbacks, to increase the holding capacities of waste storage, to encourage greater containment of waste, to increase the number and frequency of measurements and the reporting of soil nutrition levels and other potential contaminants, and to move toward increased producer education as a requirement for certification.

Site location decisions, as well as adoption of appropriate technology to reduce the potential of air and water pollution, have become major considerations in hog production. The site decision must include considerations of location relative to streams and waterways, soil characteristics if a lagoon or other waste storage facility is to be built (with preference for high clay content soils that can be packed to eliminate or reduce the potential of seepage or leaching of high concentrations of nitrates and other potential pollutants into underground water supplies), and the availability of adequate land for waste application. Also of concern is the issue of location relative to urban centers and/or neighbors who may be subject to odors or air pollution from the production facility or from the disposal of animal wastes. Conflicts over siting of livestock facilities and land use will be a dominant feature determining where the industry will grow and where it will decline.

To date, most of the environmental guidelines have been at the state level. However, it is possible that the federal government will establish more standardized regulations in the future. Federal standardization of regulations could have an impact on regional growth or decline in the industry that results from variances in regulations from area to area. Also important will be the Environmental Quality Incentive Program (EQIP) authorized under the 1996 Farm Bill and similar legislation expected in the future that will encourage environmental stewardship in livestock production. The EQIP program is designated to allocate \$100 million annually to livestock producers to help share the costs of increased environmental management structures and practices.

Nutrient loading on farm land from waste disposal is a major concern. Maximum nutrient loading in Indiana, for example, is based on an application rate of 150 pounds of available nitrogen per acre per year. Available evidence indicates that in some major producing areas, such as certain counties in North Carolina, nutrient application rates already exceed amounts that can be recycled effectively, while in other states, such as Iowa, nutrient loading is nowhere near the maximum level that can be recycled through crop production. Air quality poses a serious scientific challenge in terms

of establishing a measurable standard for offensive odors. Separation from neighbors, bio-covers on waste handling and storage facilities, and the use of best management practices in manure disposal are odor control mechanisms that will increasingly be required of producers.

An industrialized pork sector will increasingly be treated like manufacturing or any other industry when it comes to environmental regulation. Many pork production units have been exempt in the past from the environmental regulation faced by much of industry, in part because of the difficulty of regulating and monitoring non-point compared to point sources of pollution, and in part because of the small scale of many farms compared to the manufacturing complex. But as the industry becomes more industrialized, the rationale for exemption from regulation become less persuasive. As in most other industries, more environmental regulation will likely increase costs, and smaller scale units will find compliance with environmental rules both more difficult and higher cost compared to larger scale units.

In recent years, there has been a groundswell of opposition to new hog units or expansions of existing units. This opposition takes the form of local citizens who protest the proposed hog units due to their desire to protect the water, the air, their own property values, the health of their families, and their right to an acceptable lifestyle that will not be adversely affect by hog production. Often the concerns are heightened due to the size of the proposed unit. In may cases, these groups have been effective in getting investors to seek another site, in convincing existing producers not to expand, or in causing a delay or abandoning of the investment all together.

As to the environmental end result of a more industrialized and larger scale hog industry, the prospects are not clear. A larger proportion of production units will likely be subject to increasingly stringent environmental regulation, resulting in less potential environmental degradation. But with larger scale units, if there is an environmental accident, the consequences are more severe because of the increased concentration of pollutants.

The challenge to government is the development of regulation that enables a cost-competitive pork industry to operate in an environmentally sound manner.

### **Animal Well-Being**

Animal welfare is rapidly becoming a major concern in animal agriculture. Increased regulation of the living environment for animals has been a predominant theme in Europe in recent years, and concerns are being expressed about the welfare of animals in the U.S. as well. It is not only an issue of the production practices used by farmers to increase efficiency, including confinement facilities, nutrition practices, and health care, etc., but also the handling of animals in the marketing chain, including treatment by truckers, marketing agencies, and packing plants. Furthermore, the animal rights/animal welfare issue also involves such diverse dimensions as the use of animals in research by the medical profession and scientific community; the use of animals for sporting purposes by the horse, dog racing, and hunting industries; and the care and treatment of pets and companion animals.

The relationship of humans to animals has been evolving for centuries, but only in recent history has it become a focal point of public policy. The manifold issue of animal rights and animal

welfare has the potential to become one of the most complicated issues facing the pork industry. Producers will have to recognize the legitimate concerns of animal welfarists if they expect to help shape this dimension of animal agricultural policy. Use of the best management practices to improve animal well-being, as indicated by scientific research, may well be the most effective management practices in terms of reducing costs and conflicts. Although promulgation of new swine care regulations is not likely to be a serious problem for the U.S. pork industry in the foreseeable future, swine care standards may well be an issue in the sale of pork products in international markets.

### **Worker Safety**

Occupational Safety and Health Administration (OSHA) regulations establish the duties of employers and employees relative to achieving a workplace that is free from recognized hazards that cause or are likely to cause death or serious harm to employees. These regulatory requirements not only provide for sanctions and fines if they are violated, but are likely to be a factor in negligence lawsuits stemming from workplace accidents on any farm or other business where the regulations have been ignored.

The so-called general duty clause of the OSHA Act applies in any situation where no specific mandatory health and safety standard has been adopted. It requires employers to furnish employees with a workplace free from recognized hazards. Rules concerning employee entry into potentially hazardous confined spaces such as manure storage pits are of particular concern in hog production. An equally serious issue is the potential of chronic, long-term health problems of continually working in confinement facilities that have a high concentration of ammonia and other gases.

Similar to environmental regulation, an industrialized pork industry is expected to be less exempt from current labor regulations that impact most other industries. Production agriculture is one of the more hazardous occupations in terms of worker safety, yet because of the small scale of most firms, much of the industry is not regulated by OSHA and/or under more recent Worker Protection Standards legislation. Largely as a function of increased scale as one moves to an industrialized industry, but also because of more complexity in the work-place, an industrialized pork sector would be expected to encounter increased regulation concerning the work environment and working conditions of its employees. More producers will need employee training programs, policy manuals, warning signs, etc., in order to minimize risks to employees, manage exposure to liability, and provide a foundation for effective personnel management. These regulations will again increase costs, with small-scale units encountering more difficulties and higher costs of compliance.

### **Concentration and Control**

Concentration and control issues are complex and multidimensional. First is the concern about fewer firms and increased concentration in the processing industry and the implications for market power and price exploitation. In reality, this is not a new issue; in fact, concern about monopoly power earlier this century resulted in the Consent Decree in 1920, whereby meat packers agreed not to monopolize markets rather than be subject to prosecution under the Sherman Antitrust Act. Although the current major concern with respect to market power is the high concentration in the beef packing industry, similar concerns have been raised about concentration in the pork and poultry industries. Experience in the poultry industry suggests that concentration initially results in lower

prices and increased responsiveness to consumer needs. Larger producers and processors as well as consumers will likely benefit, but smaller firms find it difficult to compete. The critical question is, when does concentration become a deterrent to lower prices and greater economic efficiency?

A related issue is concentration in the production sector. Producers in the swine sector are raising questions about trends to larger scale operations and integrated production in those industries. As the processing industry becomes more specialized with larger plants, flow scheduling to maintain throughput at plant capacity becomes increasingly important for efficient operations. Consequently, there will be increased pressures in the pork industry to coordinate the production and processing activities to keep both feedlots and packing plants operating at peak efficiency. Questions concerning such issues as control of production, processing, and distribution; the future of the family farm and independent producers; and contract production have been and will continue to be heavily debated by state legislatures and to a lesser degree at the federal level.

Concern about market access, price discovery, and market efficiency are also important issues as the hog/pork industry moves to increased vertical linkages where pricing is done by contract or other negotiated arrangements rather than through open market mechanisms. Recent U.S. studies of these issues in the red meat industry have not resolved the issues, but have stimulated the debate and resulted in policy recommendations for voluntary disclosure of price and sale terms by both buyers and sellers for all product sales (whether under contract or open market) between producers and packers or first handlers. Whether mandatory reporting is eventually required will depend in part on the success of a voluntary system. But the issues of price discovery and market access as pork markets become less “public” and more “private” will have significant implications for the industry and individual firms, particularly those that are not aligned and are dependent on increasingly thin markets for pricing information.

## **Implications for the Future**

### **Site-Specific Micro Production Management**

The management of production is expected to trend toward more micro management of each specific production site, specific room, and possibly even specific animals. The shift will be driven by the influx of information about the environmental and biological factors that affect production. The motivation will be to minimize costs and enhance product quality.

Increases in monitoring will greatly expand the amount of information available regarding what affects animal growth and well-being. In addition, greater understanding of how these factors interact to affect biological performance will be forthcoming. This understanding will then be designed into management systems which incorporate the optimum combinations and apply them at a micro or localized level. The localized level may be at a specific site, or be applied to a specific room or group of animals, or may even be fine-tuned to the individual animal. This will be made possible by individual monitoring and control systems.

Examples include medication treatment by animal rather than by the entire group or the herd; nutritional feeding to the specific genetics, sex, age, health, and consumer market for the individual animal; and continuous adjustment of the ambient environment, including such factors as temperature,



humidity, air movement, and dust and gas levels within buildings, to maximize economic returns.

The level to which micro management will be applied is still to be determined. It is clear that the industry will increase understanding of the interaction of all these factors and how they impact growth, but individual monitoring of animals would be very costly. The alternative direction that has been pursued in the past has been to develop systems with standard management practices for large groups of animals in order to gain economies of size. This involves defining a “best technologies system” based upon current knowledge of the interaction of factors such as genetics, health, nutrition, environment, and market, then applying that system to a large number of animals by replicating the system unit after unit. The level of micro management application will be determined by the tradeoff of the cost of the technology relative to the added gains that can be achieved. The ultimate objective will be to standardize the basic system and to micro manage at the smallest scale that provides positive returns.

### **Supply Chain Optimization**

An increasing emphasis will be placed on managing and optimizing the pork supply chain from genetics to end-user/consumer. This supply chain approach will improve efficiency through better flow scheduling and resource utilization, increase the ability to manage and control quality throughout the chain, reduce the risk associated with food safety and contamination, and increase the ability of the pork industry to quickly respond to changes in consumer demand for meat attributes. Improved inventory management will be a critical part of the more disciplined logistics and flow scheduling component of supply chain optimization.

A supply chain approach will increase the interdependence between the various stages in the pork chain; it will encourage strategic alliances, networks, and other linkages to improve logistics, product flow, and information flow. Some have argued that in the not-too-distant future, competition will not occur in the form of individual firms competing with each other for market share, but in the form of supply chains competing for their share of the consumers animal protein expenditures.

### **Environmental Control and By-Product Utilization**

One of the most critical issues that will shape the structure and location of the pork industry in the future is that of the disposal of the waste and other by-products from production and processing, and the mitigation of air and water pollution from the industry. Strategies to solve by-product disposal and environmental problems include the recycling of animal waste, processing waste into productive resources to be used in agricultural or industrial processes, the enclosed containment of waste for later disposal, a technological decomposition process to dispose of waste, mitigation of odors through appropriate additives or changes in the feeding regime, and the relocation of the industry to geographic regions of the U.S. (or the world) where there is more environmental absorptive capacity (lower population density, dryer climate, fewer surface waterways, less permeable soils, etc.) or to areas of the world more willing to exploit their environment. Until and unless technological fixes to environmental and order problems occur, this challenge will dramatically affect the size, location, and structure of the hog/pork industry.

## **Production Associations**

Those pork producers who are not part of a supply chain or a production-processing center will likely improve their competitive position by becoming a member of a producer association that can become a qualified supplier for processors/distributors/wholesalers and retailers further up the chain. These producer associations quite likely will provide a broad spectrum of services to their members, including information, nutrition, genetics, pharmaceuticals, and marketing assistance. Such associations may be similar in concept to closed cooperatives that currently serve the industry, but producer associations will generally be larger and more focused on standardization of production techniques and technology, product attributes, and operating procedures.

## **Trace-Back and Controlled Origination**

For a food company, a key risk that is difficult to manage is that associated with food safety. The issue of food safety is beyond one of consistent quality—food products that make people ill or even cause death can quickly destroy brand value, the most valuable asset owned by a branded food product company. One way to manage food safety risk is to monitor the pork production distribution process all the way from final product back through the chain to genetics. A trace-back system combined with HACCP (Hazard Analysis Critical Control Points) quality assurance procedures facilitates control of the system to minimize the chances of a food contaminant, or to quickly and easily identify the sources of contamination. Trace-back is part of the motivation for controlled origination of raw materials from certified suppliers to implement a supply chain philosophy in the pork industry.

## **Heightened Risk from New Sources**

The industry will need to recognize the likelihood of new instabilities and financial risks from factors not previously considered. Greater variation in feed grain and protein prices appears likely under the 1996 Farm Bill. The movement to large production and processing centers has potential for great disruption when one of these plants shuts down. Contract production brings the new risk of potential contract termination.

Globalization also brings its concerns. Greater dependency upon export markets increases the instability from exchange rate fluctuations, changing political policies in foreign countries, and weather conditions around the world. Trade disputes and disease outbreaks in foreign lands will have greater impacts on the U.S. industry, as demonstrated by the break of Foot and Mouth disease in Taiwan. Foreign policy such as Japan's decisions of when to apply and release GATT safeguards will have major impacts on the U.S. In addition, other countries such as Mexico, Brazil, and Argentina may attempt to develop pork export programs to the U.S. market.

Larger specialized production units may also be more vulnerable to these risks than in the past. As an example, a diversified hog and corn farm had the stabilizing advantage. Now, specialized units have less diversification advantages and by sheer size face enormous risk both on the feed price and hog price sides of their businesses. Therefore, the level of total profits on many farms may be more volatile and may come from causes not considered in the past.

The contrary argument is that larger production units and a more highly coordinated pork systems will have enough of a stabilizing influence to offset the new uncertainties listed above. Which has the greatest magnitude is debatable, but it is clear that the uncertainties may arise from some new areas.

### **Production-Processing Centers**

The supply chain optimization concepts have a significant implication for the growth of the industry. In the past, decisions concerning the location of the production, processing, and distribution centers were made in a relatively independent fashion; that will no longer be the case in the future. In particular, optimal slaughter/processing plant capacity is very large, requiring significant capital outlays and adequate supplies of raw material for efficient operations. It is unlikely that new plants of optimal size will be constructed in the future with the expectations that production systems will develop to supply those plants. Likewise, producers are not expected to invest in production capacity if access to processing plants that can bid competitively for their hogs is not assured.

These concerns, combined with the benefits of an integrated system in terms of cost efficiencies, quality control, flow scheduling, and inventory management, will result in the development of production-processing centers and the supporting infrastructure as the optimal strategy for growth and expansion in the industry. This strategy will not only influence the geographic location of the industry, but further increase the interdependence between the segments of the industry. In addition, it becomes less likely that new processing capacity will be built unless a sizable portion of that capacity can be assured from some individual live hog production firm or organization of pork producers.

### **New Processing Technology**

Technological advances in production and processing could dramatically alter the labor requirements to manufacture pork. The role that robotics may play in pork slaughter and processing is unclear. The constraint of labor availability in both production and processing could be reduced by greater substitution of capital for labor. Parts of the production process could become more automated, including waste handling, feed handling, animal handling, and administering pharmaceuticals, etc. Electronic monitoring systems that can detect disease organisms in the air as well as in the animal may enable preventive medication to be automatically administered when needed rather than on a constant basis such as with current antibiotic use in feed—or in controlling a disease outbreak after it occurs, as is commonly the case now. Electronic monitoring and measuring devices to determine real-time carcass quality characteristics would be useful in rewarding producers for those attributes and in segmenting products into proper categories for efficient distribution to different customer categories or end-uses. Perfection of mechanical trimming and boning are other potentials in processing. Electronic automation technology is just another example of the manufacturing mentality applied to the pork production/distribution chain.

### **Enhance Market Share**

In the longer term, the opportunities to improve production efficiency in the pork chain are profound if one looks at the poultry and seafood industries as potential models. One of the biological

advantages of pork production compared to other red meats is the multiple birthing process, which allows both increased efficiency from improved reproductive performance and faster gains in production efficiency through genetic manipulation compared to beef and sheep. Improvements in feed efficiency are also likely if past history is repeated. This increased efficiency is likely to result from site-specific micro management.

In fact, from a cost perspective, one might argue that the combination of improved reproductive efficiency and feed efficiency will result in more rapid declines in the cost of producing animal protein in the form of pork compared to beef and possibly even poultry. In addition, the industry's current structural change is displacing inefficient operations with more efficient ones. Therefore, on a cost-competitive basis, the pork industry in the long run has more potential to improve its market share from a cost of production and chain coordination perspective than other animal proteins.

### **Product Attributes and Diversity of Use**

Expanding the current interest in the pork industry on quality to include other attributes such as freshness, texture, palatability, aroma, and other dimensions could result in significant opportunities to position pork products into different market niches and segments. Again following the model of the poultry industry, pork has significant opportunities to broaden the scope of product uses. Positioning pork so that it has products available to be eaten at all meals and as a snack food is critical. In addition, if pork can develop consistent taste, texture, and aroma for each specific product, significant market growth opportunities will exist.

### **Global Ownership**

A major change in U.S. and world pork production and distribution will be that of the globalization of ownership and operations of production/distribution firms. Japanese pork production/distribution companies have already invested in production and processing systems in the U.S. (Oklahoma, Texas, Wyoming, Indiana). Constraints on expansion of pork production in Europe may encourage the European pork companies to locate satellite operations in the Pacific Rim and/or the U.S. U.S.-based companies have already invested in processing capacity in Canada (IBP) and Mexico, and are investigating other countries of South America. Eastern Europe and Asia may also be considered by U.S. firms. The pork production/distribution industry is clearly becoming global in scope, not only with respect to product exports and imports, but also with respect to internationalization of production and processing facilities. Today's technological systems can easily be transferred to other areas of the world, which provides an environment where internationally focused pork firms will likely build capacity offshore. In the future, five to 10 global pork firms could dominate world production and processing.

---

## Key Questions & Responses

- **Can small producers compete?**

The best answer is yes, but it depends. For producers with old technology who have less than 100 sows, hog prices are expected to cover feed and other variable costs of production, but will likely be inadequate to cover depreciation and other fixed costs. Most producers of this size will be able to continue operating until buildings and equipment need replacement; then they will consider other alternatives.

For those producers in the 100- to 300- (or possibly 600-) sow size category, networking with other producers in a cooperative or other form of alliance will have high payoff in terms of increased specialization and reduced cost of production, access to markets and market premiums, access to high quality genetics and other inputs, and better information and management skills. Increasing to a 1200-sow size results in even lower costs and better market access both in the input and product markets.

For small-scale producers, the operating principle is not necessarily that you have to be big, but you have to look big through networks or alliances to obtain the efficiency and market access benefits of size.

- **Where will the industry locate?**

In the next seven to 10 years, the key determinate of location of the industry will be the environmental absorptive capacity of the area. This suggests that the industry is likely to move to those geographic parts of the U.S. and the world that have the lowest population density, the driest climates, and the most attractive communities from an incentive/regulatory perspective. Improvements in transportation efficiencies have resulted in most resources becoming increasingly mobile; and hog production will not necessarily be located in feed surplus regions. This suggests that the U.S. hog/pork sector will likely move to those parts of the Midwest, the Southwest, and the West that have lower population densities and higher ability to absorb or mitigate animal waste and odor problems.

Access to large-scale packing plant capacity suggests that hog production will be increasingly concentrated geographically in relatively close proximity to a slaughter plant. Some U.S. pork production companies will locate integrated production and slaughter plants in other countries, including the Prairie Provinces of Canada, Mexico or Latin America, and Australia or somewhere in the Asian continent to supply the increased pork demanded in that part of the world.

- **Will foreign demand continue to expand, providing opportunities for U.S. exports of pork?**

The rising real incomes of consumers in Asia and other parts of the world suggests increased demand for food. And a common response of consumers with growing incomes is to improve the quality of their diet by substituting animal proteins for cereals and vegetable proteins. Increased feed efficiency, combined with improved reproductive performance, should enable pork producers worldwide to reduce absolute costs of production and possibly even narrow the gap between poultry and pork. These efficiency improvements will also likely widen the gap between pork products and higher cost beef products.

The increased incomes of consumers worldwide, combined with the potential for lower pork prices relative to other animal proteins, suggests continued strong export potential. Reductions of trade barriers and less emphasis on self-reliance in pork production will be important determinants to track. The key concern that mitigates unbridled optimism is the potential of increased pork production in other parts of the world that will compete with the U.S. in an expanding world market.

- **How will odor and environmental problems of pork production be resolved?**

In the short to intermediate run (the next five to seven years), environmental and odor problems associated with pork production will be solved primarily by relocating the industry to areas that have lower population density and less surface water to pollute. In the longer run, technological breakthroughs with respect to feeding regimes have the potential to reduce the total animal waste produced. Other technological advances with respect to building design, waste containment, feed additives, effluent additives, etc., also have the potential to reduce environmental and odor problems.

But it is not clear that these technological fixes will result in the pork industry relocating back to higher population density regions of the country once the infrastructure and support industries have moved elsewhere. This is particularly the case with continued mobility of resources, improvements in transportation and distribution efficiencies, and reduced constraints on national and international resource and product movements.

- **Will capital be available to finance the expanded production and processing capacity?**

The capital markets are increasingly efficient at allocating funds to those industries and those geographic areas which exhibit comparative advantage. Capital generally has not been a constraint for developing increased production capacity in the industry during the past few decades, and there is little reason to believe that the capital markets will not continue to provide adequate financing for future expansion.

This does not mean that everyone who wants to increase the size of their hog operation has had access to adequate capital in the past or will have access to capital in the future. Increasingly, the capital markets are allocating funds to those who exhibit superior performance in terms of cost control, profit margins, and risk management. Lenders are particularly conscious of risk considerations and will increasingly impose discipline on their customers to be efficient and to utilize the best strategies in managing risk.

This suggests that an increasing proportion of the production will occur in integrated production/distribution systems, not only to capture the efficiencies of such a system but to reduce the risk exposure in terms of market prices and quantity as well as quality dimensions. Consequently, it will be increasingly difficult for independent producers to access adequate funds unless they adopt current technology and use management strategies to reduce the risk exposure they and their lenders will face.

- **Will the U.S. be competitive as a producing region in worldwide markets?**

Relatively low-cost feed and other inputs, combined with modern technology and well developed input and product markets, institutions, and a distribution system, enable the United States and the North American continent in general to be very competitive producers and suppliers of quality pork products at competitive prices. These fundamental absolute advantages of the U.S. pork

production and distribution sector are not expected to be seriously challenged.

As noted earlier, however, environmental and odor problems may be significant deterrents to locating pork production and distribution systems in various areas of the U.S., making it relatively lower cost to locate production in other geographic regions of North America and possibly even the world. It is highly likely that much of this expansion in production to meet growing worldwide demand for pork will be by U.S.-based integrated production/distribution firms or alliances, regardless of whether the plants are located in the U.S. or elsewhere in the world. But the U.S. industry cannot rest its competitive case on low cost alone—it must adapt products to specific markets and provide enhanced quality control and health and safety assurances.

- **How rapidly will pork production move to an industrialized model of production and distribution?**

Industrialized pork production is now the norm for most expanding firms in the industry. The manufacturing approach to pork production and distribution is essential to maintain quality control as well as to control cost. In many cases, this industrialized model of production and distribution will foster larger scale firms; in 1988, approximately 5 percent of total pork production was concentrated in the hands of the 40 largest firms, whereas the 40 largest firms in 1996 produced approximately 31 percent of the total U.S. pork output. Technological advances combined with continued pressures to control costs and improve quality are expected to provide incentives for further industrialization of the industry.

- **Will integrators take over the pork industry?**

It depends on how you define integrators. The pork industry is expected to be increasingly aligned from consumer back through genetics, but this alignment is not likely to be through ownership, as is common in the poultry industry. A more likely form of vertical coordination will be through joint ventures, contracting, strategic alliances, and other negotiated rather than ownership forms of coordination. Pressures will abound to develop more formalized supply chains that increase the interdependence between the various stages in the production and distribution channel.

But it is not clear who will be the chain coordinator. In some cases it might be integrators as we know them today—production firms that contract others to finish pigs and then market these animals through contractual or other arrangements to the slaughter plants. In other cases, the chain coordinator may be a regional cooperative that owns production and slaughter facilities and has a branded product in the store, or local producers who organize production and processing. In some cases, the integrator may be the feed company or a genetics company.

Various forms of vertical linkages and alliances are likely to occur, depending in part on who is a first mover. The most accurate prediction is that traditional independent production without formalized linkages both to input suppliers and processors is probably going to be a rapidly diminishing component of the pork industry.

- **How will food safety rules and quality issues impact the industry?**

Concerns about food safety and quality will be major drivers of structural change in the industry, both in terms of the processes used in pork production and distribution, and the coordination of the pork production and distribution chain. Quality concerns will drive more systemized production and distribution processes to reduce product variability and improve conformance with quality standards and consumer expectations of uniform product attributes.

Concerns about food safety and a drive to qualified suppliers and trace-back will increase the pressures and the payoff of tighter coordination along the production and distribution chain. Pressures for improved quality control and reduction of food safety risk are not expected to abate in the future and will increasingly become a source of strategic competitive advantage exploited by the private sector rather than simply compliance with government rules and regulations.

- **Will pork comprise a larger proportion of the consumers food expenditures for animal proteins?**

Pork has the potential to become an increasingly larger component of the typical consumer's diet of animal proteins, but this will require an expanded product line, further enhancement of quality, and continued reduction in cost relative to other animal proteins. All three of these goals are realistically achievable, but their accomplishment will require coordinated efforts by all segments of the industry and increased cooperation and collaboration rather than competition among the various segments or stages of the industry.



## References

- Baker, David E. "Agriculture and the Occupational Safety and Health Act." *Agricultural MU Guide*, University Extension, University of Missouri-Columbia, March 1991.
- Boehlje, Michael, et al. *Positioning Your Pork Operation for the 21st Century*. West Lafayette IN: Purdue Cooperative Extension Service, March 1995.
- Hurley, Terrance, Peter Orazem, James Kliebenstein, and Dale Miller. "Employee Management: Special Report No. 2." Supplement to *National Hog Farmer*, December 15, 1996.
- Jones, Don D., and Alan L. Sutton. "U.S. Animal Manure Management Regulations: A Review and a look at What's Coming." Proceedings at Ag Forum, Purdue University, January 1997.
- Meyer, Steve R. "U.S. Slaughtering Capacity, February 1996." *1996 Pork Industry Economic Review*. National Pork Producers Council, March 1996.
- National Pork Producers Council. *Swine Care Handbook*, <http://www.nppc.org/>
- "OSHA and Its Implications for Agriculture," *Lesson 10, Class Lesson Plans for ASM 350, Safety in Agriculture*, Agricultural Engineering Department, College of Agriculture, Purdue University.
- Thu, Kendall, ed. "Understanding the Impacts of Large-Scale Swine Production," *Proceedings from an Interdisciplinary Scientific Workshop*. The North Central Regional Center for Rural Development at Iowa State University, June 1995.
- U.S. Department of Agriculture. "Hogs and Pigs," NASS, quarterly issues 1980-1997.