

**COORDINATION IN THE
UNITED STATES
HOG/PORK INDUSTRY**

by

Lee F. Schrader

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Dept. of Agricultural Economics

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(A Contribution to a Multi-country Study of Vertical Coordination in the Hog/Pork Sectors of Denmark, Canada, Netherlands, and United States of America)

by

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Abstract

This contribution to a multi-country study of vertical coordination in the hog/pork sector provides a primarily descriptive analysis of coordination of the U.S. hog/pork industry. A common framework of review and analysis is used to facilitate comparison of the industries in Canada, Denmark, Netherlands, and the U.S. The concepts of chain management are used to reach some conclusions regarding the U.S. industry to compete in world markets. Parallel coordination systems are identified. Lack of trust is found to limit development of closer coordination and to limit communication of users' preferences upstream in the sector.

Keywords: Vertical Coordination, Supply chain, Swine sector

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COORDINATION IN THE UNITED STATES HOG/PORK INDUSTRY

by
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Preamble

This study represents the United States contribution to a Multi-country study of vertical coordination in the hog/pork sector, the DECANETHUS Project. The Agri Chain Competence Foundation, a research group funded by the government of the Netherlands, originated this project as a part of a comprehensive research program designed to better understand vertical coordination and supply chain Management across all sectors of the global agri-food sector. Four countries are involved: Denmark, Canada, the Netherlands, and the United States of America.

Researchers in each of these countries formed a working group that defined a framework for analysis which was applied across all the countries. Each country has produced a report consistent with the agreed framework. A DECANETHUS project report which attempts to draw broad conclusions about vertical coordination based on the experiences outlined in each of the county reports and jointly authored by the country participants is to be published by the Agri Chain Competence Foundation.

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Executive Summary

This study of coordination of the hog/pork industry in the United States is part of a project including the industries in Canada, Denmark, the Netherlands and the United States. The U.S. represents a large market destined to be part of an even larger North American Market with free movement of animals and pork products and limited regulation to protect human and animal health, to deter unfair competition and to protect the environment.

Domestic consumption of pork has been relatively stable while use of poultry increased and that for beef declined. The U.S. has moved from being a net importer of pork to a net exporter position in the past five years.

All aspects of the hog/pork industry are in process of change. These changes involve the product desired by consumers; size and location of production and processing operations; and the nature of relationships in the pork supply chain.

Breeding (genetics) companies have gained a dominant share of the breeding stock business at the expense of traditional family farm purebred breeders. Hog production technology has accelerated change to larger production units and spawned the fifty very large companies that now account for forty percent of sows in the country. Slaughter is concentrated with the six largest firms accounting for 72 percent of capacity. Processing (beyond primal cuts) is also concentrated and, to some degree, integrated with slaughter operations.

Coordination is achieved by a variety of methods in a number of parallel channels. The hog-pork sector has been primarily a market coordinated system. Recent developments in consumer preferences for pork and concentration at all levels of the pork chain have encouraged the

development of non-market relationships among the stages of the system. A lack of trust among firms limits the strength and duration of relationships.

Typically, only a segment of the business of slaughter and processing firms is such that very tightly specified hog production conditions are needed to meet final product specifications. Transfer prices in most non-market relationships are market price dependent. Dependence on open market quotes for transfer prices will cause problems if, as expected, more transfers are arranged without currently negotiated pricing.

In principle, meeting consumer needs implies that the drive for closer coordination would be from the downstream end of the chain. In fact, one sees more interest in development of continuing relationships from upstream. That is, the large producers are searching for relationships with slaughterers, slaughterers seeking continuing relationships with processors and retailers, and so on. Food service is the exception where the large food service chains are more likely to initiate continuing relationships or alliances with suppliers.

Seasonal and cyclical variation in pork production suggests that pork production is not primarily demand driven. Declining real prices over the past 20 years indicate continued increase in production and processing efficiency. There remains room for improvement in effectively communicating the quality message from pork consumers to hog producers. A trend toward more tightly specified end product quality and product flow suggest the need for managing the full chain from genetics through retailing. Quality assurance is becoming more important. Further adjustments in system coordination will be needed for the pork industry to remain competitive in a world market for foods.

Introduction

This overview of coordination in the United States hog/pork industry is part of a larger analysis of the hog/pork industries in Canada, Denmark, the Netherlands and the United States. The country studies follow a similar format. A separate summary publication draws conclusions from the country studies.

The analysis begins with a review of the market for pork. Section two addresses the business environment and section three is a descriptive analysis of the pork supply chain. Section four provides observations on the performance of the chain followed by sections on the pressures for change and capacity to respond. Conclusions and implications for the pork industry are provided in the final section.

The U.S. pork system is in the process of major structural changes. These include technology, size of operations, location, and product characteristics. Hog production is changing from family based, small scale, independent farms to more specialization, larger farms, and less dependence on market coordination between stages in the system. Hog production is moving toward industrialization and increased management intensity. Virtually all relationships in the pork chain are in transition. Major drivers of change are domestic and foreign demand, technology, policy, and regulation. The policy agenda is dominated by the very large hog producers and those concerned about the effects of these large units on the industry and the environment.

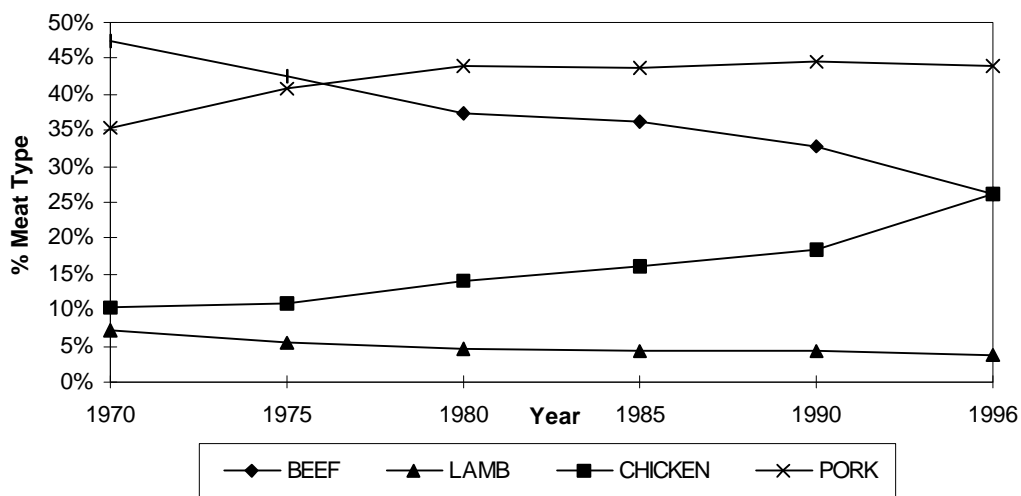
The Pork Market

World Market

Consumption

Pork has accounted for the largest share of world meat consumption since the mid 1970s. World pork consumption has increased over 200 percent from 1970 to 1996, when it reached 76.33 million tonnes. Chicken consumption has also increased dramatically over this period and continues to show a higher rate of growth than pork. Beef and sheepmeat consumption have been declining steadily (see Figure 1). China, the European Union (EU), the United States (U.S.), the Former Soviet Union (FSU), and Japan accounted for 86 percent of total world pork consumption in 1996. In terms of per capita pork consumption, Hong Kong ranks first at 41.0 kg followed by the EU (38.9 kg), China (31.9 kg), the U.S. (30.8 kg) and Canada (27.29 kg). Japanese consumers ate 16.8 kg/capita while the FSU consumers ate only 9.4 kg. Within the EU, per capita pork consumption is quite high in some countries (Denmark: 65 kg, Spain: 52 kg, Germany: 46 kg, The Netherlands: 45 kg). The largest net importers are Japan, the FSU, and Hong Kong. On an aggregate basis, the EU is a net exporter but Germany, Italy and the U.K. are very large net importers (Table 1).

Figure 1: Shares of World Meat Consumption, 1970-1996



Source: USDA

Production

World pork production increased about 200 percent from 1970 to 1996 when it reached 76.82 million tonnes (Table 2). China is the largest producer, accounting for 51 percent of total world production in 1996. The European Union is second at 19 percent (Germany 3.8%, France 2.9%, The Netherlands 2.1%, Denmark 2.0%, Belgium 1.3%), followed by the United States at 11 percent. Canada accounted for only 1.6 percent of world pork production in 1996. Collectively, China, the European Union, the United States, the Former Soviet Union, Japan and Canada produced 87 percent of total world pork in 1996.

U.S. production expanded very little between 1970 and 1990, but, has since expanded to 8.3 million tonnes in 1996. Canada's production has changed little since 1980. Production in the European Union has grown by 49 percent between 1975 and 1996. Production in the Former Soviet Union has declined sharply since 1990 as a result of economic and political collapse. Chinese production increased dramatically (450 percent) from 1975 to 1996. Production in Japan doubled from 1970 to 1980, increased slightly in 1980s and 1990, but has since declined due to increasing environmental costs. In Taiwan, production more than doubled from 1980 to 1996, however an outbreak of foot and mouth disease in 1997 will cause a drop in production there.

Trade

Volume of world trade in pork increased by about 6 to 7 percent between 1970 and 1996. The EU, the U.S., Canada, China and Taiwan accounted for 96 percent of total world pork exports in 1996 (Table 1). Canada accounted for 6 percent of world pork exports in 1996 up from 2 percent in 1970.

Table 1: Major Pork Exporting and Importing Countries, 1996 (1000 tonnes)

EXPORTERS				
Country	Production	Consumption	Exports	Net Trade
European Union-15	14,488	13,473	3,923	+ 1,020
Denmark	1,540	340	1,230	+ 1,200
Netherlands	1,650	695	1,050	+950
Belgium	1,028	560	558	+468
France	2,190	2,100	500	+90
Germany	2,914	3,719	200	-805
Taiwan	1,175	880	300	+300
China	39,000	38,790	210	+210
Canada	1,250	955	335	+295
U.S.	8,312	8,199	408	+113
Poland	1,898	1,878	20	+20
IMPORTERS				
Country	Production	Consumption	Imports	Net Trade
European Union	14,488	13,473	2,903	+1,020
Germany	2,914	3,719	1,005	-805
Italy	1,371	1,915	613	-538
France	2,190	2,100	410	+90
United Kingdom	1,031	1,324	428	-293
Spain	2,080	2,062	54	-38
Japan	1,315	2,120	800	-800
FSU-12	2,535	2,835	300	-300
U.S.	8,312	8,199	295	+113
Hong Kong	9	226	227	-227
Mexico	890	952	70	-62

Source: Data compiled from Production, Supply and Disposition View Database, USDA, 1996.

Table 2: Pork Production by Country/Region (1000 Tonnes)

Country/Region	1970	1975	1980	1990	1996
United States	6,667	5,343	7,537	6,965	8,312
Canada	746	655	1,034	1,133	1,250
European Union	8,152	9,730	11,687	14,084	14,488
USSR/FSU	3,194	5,651	5,183	6,642	2,535
China	n.a.	7,094	11,341	22,808	39,000
Japan	734	1,039	1,475	1,555	1,315
Taiwan	320	322	537	1,009	1,175
World Total	25,545	39,126	49,552	64,988	76,819

Source: Data compiled from Production, Supply and Disposition View Database, USDA, 1996.

In terms of exports as a percent of production, the world's largest traders were EU (27.07 percent) (Denmark: 79.9 percent, the Netherlands: 63.6 percent, Belgium: 54.3 percent), followed by Canada (26.8 percent) and Taiwan (25.5 percent). While China exported only 0.53 percent of its production, it ranked as the fifth largest exporter in 1996.

U.S. Pork Market

Per capita use of pork in the United States has remained relatively constant in the range of 22-24 kg (retail weight) since 1985 (Table 3). Thus, total domestic use has increased only at the rate of population increase. Retail pork prices increased at the rate of about 2.86 percent per year during the same period, somewhat less than the rate of inflation at 3.49 percent per year. This would imply a slight decrease in demand in real terms on a per capita basis. Poultry meat use has increased substantially during this period, primarily at the expense of beef consumption.

Table 3: U.S. Pork Consumption

Year	Per Capita Disappearance			Total Consumption
	Carcass Weight	Retail Weight	Boneless Equivalent	Thous MT
	kg	kg	kg	
1985	30.16	23.54	21.82	7196
1986	28.53	22.23	20.68	6865
1987	28.67	22.27	20.82	6964
1988	30.57	23.77	22.27	7506
1989	30.39	23.54	22.14	7516
1990	29.08	22.59	21.18	7271
1991	29.44	22.86	21.46	7439
1992	30.75	23.86	22.41	7926
1993	30.62	23.77	22.35	7779
1994	31.03	24.09	22.63	8087
1995	28.71	22.27	20.96	8067
1996	28.71	22.27	20.96	7627

Source: USDA, Economic Research Service, Livestock, Dairy, and poultry Monthly.

Foreign demand presents another picture. Pork exports increased from approximately 50,000 metric tons in the mid 1980s to over 400,000 metric tons in 1996. During the same period, imports decreased from the area of 500,000 tons to under 300,000 tons in 1996 (Tables 4 and 5). The U.S.

became a net exporter of pork in 1995. Japan, Canada, and Mexico are major export destinations and Canada, Denmark, and The Netherlands are among the major suppliers of U.S. imports. Live hog imports increased dramatically in 1995 and 1996. These live hog imports reflect increased Canadian production and excess slaughter capacity in the U.S.

Table 4: U.S. Pork and Live Hog Exports

Year	Pork, Carcass Weight				Hogs
	Total	Japan	Canada	Mexico	Head
	Metric tons				
1985	58238	13509	4569	14571	18278
1986	38857	17945	4581	1026	12993
1987	49584	28001	4280	3220	7409
1988	88556	54980	4012	15829	91292
1989	119032	67020	5892	27289	93343
1990	108145	56921	10340	17365	56652
1991	128039	55741	12258	36966	267853
1992	184311	96431	14257	48874	105631
1993	197370	100215	16495	42178	40636
1994	241308	108807	23996	68154	136148
1995	349590	165416	26205	27150	16059
1996	431659	226943	42808	25342	55883

Source: USDA, Economic Research Service.

Table 5: U.S. Pork and Live Hog Imports

Year	Pork, Carcass Weight				Hogs
	Total, all countries	Canada	Denmark	Netherlands	Head
	Metric tons				
1985	511544	191808	194243	15436	1226571
1986	508749	220111	167143	5574	503728
1987	542106	247476	156623	7870	446056
1988	515845	230778	148104	10247	835949
1989	406264	205562	89990	6921	1073646
1990	407277	198248	123943	7099	890252
1991	351431	183225	111565	8027	1057685
1992	292799	177462	76616	7663	674469
1993	335751	182471	106038	10329	840050
1994	337371	191313	110925	7606	921274
1995	301172	205899	65552	4840	1751138
1996	280724	198402	55435	3846	2779175

Source: USDA, Economic Research Service.

Industry Business Environment

Organizations

National Pork Producers Council

The National Pork Producers Council (NPPC), a producers' organization, claims a membership of 85,000 in 44 affiliated state associations. It serves as a unified voice of U.S. pork producers on a wide range of industry and public policy issues. NPPC is funded primarily from a mandatory national assessment on all U.S. produced market hogs, feeder pigs and breeding stock as well as imported hogs and pork products. Assessments at the rate of 0.45 percent of gross market value are collected by the National Pork Board, an independent 15 member board established by Congress under the Pork Promotion, Research and Consumer Information Act of 1985. NPPC is the primary contractor of services to the Pork Board.

The *Pork. The Other White Meat*[®] advertising campaign was initiated in 1987. Its aim was to reposition pork in the minds of consumers. NPPC states that 87 percent of consumers now perceive pork as "The Other White Meat." In 1995, NPPC launched the next phase of the promotion, "*Taste What's Next*[®]." This campaign attempts to position pork as the next consumer food trend. It emphasizes the goal to make "pork the meat of choice" by 2000.

A Pork Quality Assurance program has been implemented as a means to assure consumers that U.S. pork producers are determined to provide a safe, wholesome product. NPPC claims that producers marketing 60 percent of U.S. hogs participate in the program. The program uses the concept of Hazard Analysis and Critical Control Points (HAACP). There are three levels of the program with the third level requiring verification of compliance by persons other than farm owners or employees. These programs focus on reduced medication use and improved herd health status.

The organization acts as a voice for producers in legislative and regulatory matters. Environmental concerns and regulation are matters for policy analysis and research. These are difficult areas for a producer organization. Solving the environmental problems of the very large production units is not perceived as favorable to survival of smaller family farms. Similarly, the transfer of modern production technology has tended to favor large producers more than small producers. NPPC provides funds for production research, provides educational materials and seminars on technology and management for producers, and sponsors trade shows.

NPPC also sponsors a national genetic evaluation program to assist producers to provide the products consumers desire. The multiple trait evaluation will include pork eating quality. The objective is to provide unbiased information to assist producers in choosing combinations of breeds and lines to produce to fit the market profitably.

The NPPC is governed by a board of directors elected by delegates who are elected by producer/members in each state association.

National Pork Board

The National Pork Board is an independent body of 15 members, appointed by the Secretary of Agriculture, under the Pork Promotion, Research and Consumer Information Act of 1985. Members are producers from at least 12 states and/or importers. The board is responsible for the collection, distribution and program accountability for pork checkoff (assessment) funds. NPPC coordinates national and international product promotion, marketing efforts, production research, and producer education projects. The U.S. Meat Export Federation, partly funded by the Board, assists in maintaining and developing foreign markets for U.S. pork.

The Pork Board received revenues of \$58.9 million and spent \$52.3 million in 1996. Funding categories and funding are shown in Table 6. Mandatory distribution to state associations amounted to approximately \$11.7 million.

Table 6: National Pork Board Funding in 1996

Funding Category	Funding (\$ Million)
Consumer Advertising	15.2
Production Improvement	5.3
Retail Merchandising	5.3
Food Service Marketing	4.2
Pork Information Bureau	3.5
Foreign Market Development	2.5
Swine Health and Pork Safety	2.2
New Product Development	1.0

Source: National Pork Board 1996 Report.

American Meat Institute

The American Meat Institute (AMI) is an organization of manufacturers of meat and poultry products and suppliers to these businesses. AMI is the voice of the processors on policy and regulation affecting the group as well as providing services to members. AMI provides direct technical assistance and help in dealing with regulatory matters. They provide information and counseling to help members deal with the press and the public. AMI also provides educational conferences and seminars for both management and employees in the meat industries.

Joint activities through AMI are limited by anti-trust laws. That is, any actions in restraint of trade or agreements to set prices are illegal.

Cooperatives

Cooperatives have played a minor role in the pork chain in the past. Their share of feed supplied to hog producers may be as high as 45 percent in some areas, but the role in marketing has been small. More recently, Farmland Industries has attained about a six percent share of hog slaughter and other cooperative activity has also increased. Several multi-function cooperatives including Farmland, Land O'Lakes, Goldkist, and Countrymark/Growmark have production contract operations. New cooperatives have been formed to supply feeder pigs for producers. Some corn

producers have formed hog production cooperatives as a means to market their corn. These new, limited purpose cooperatives are typically formed as controlled membership organizations with specific rights and obligations on the part of members to buy feeder pigs from or deliver corn to the cooperative.

Group marketing, especially by smaller producers, is increasing. Networks have been formed to coordinate activities of specialized producers to take advantage of modern technologies such as three-site production.

Related and Supporting Industries

Feed Manufacturing

Traditionally , swine feeds have been prepared on the farm using home produced cereals as the primary energy source. Commercial feed manufacturers supply some complete feeds, however, most swine producers prepared feeds using purchased supplements (also called concentrates) or premixes plus soybean meal. Supplements include proteins, minerals, vitamins, and other additives and represent about 15 percent of the diet. Premixes do not include the protein component and make up 5 percent or less of the diet. The very large producers are more likely to prepare feeds using ingredients purchased direct from suppliers thereby integrating feed manufacture into the production firm.

In 1992, the latest Census data available, there were 151 companies with sales of more than \$100,000 producing 2,292,026 tonnes of complete swine feed, 100 companies producing 4,086,637 tonnes of supplements, and 59 companies producing 400,617 tonnes of premixes. Cooperatives account for about 21 percent of total feed tonnage.

Traditionally, feed that has not been prepared on the farm has been distributed through dealers. The role of the dealer has come into question as the size of hog production units increases. Feed manufacturers and their dealers may provide other services to swine producers including production advice, records systems, health services, credit, etc. In many cases feed dealers also sell other farm inputs. Many feed dealers have engaged in swine production by contracting with farmers to produce hogs.

Several feed companies have also assisted producers to form networks to coordinate specialized producers or to coordinate marketing. They recognize the importance of smaller producers as customers.

Health Services

Veterinary services are provided by independent individual or group veterinary practices. The very large production organizations may employ a veterinarian or veterinarians to supply services to the company. As indicated above, feed suppliers may also retain veterinary services to assist customers.

Veterinary services organizations have acquired a much expanded role in the pork chain. Many have expanded from herd health maintenance to a broader role in herd and business management. They have been instrumental in promoting and bringing together producer networks in some areas. Veterinary service organizations have, to some degree, supplanted university extension services in technology transfer.

Plant Inspection Services

The Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture operates to ensure that meat and poultry products are wholesome and that they are accurately labeled. Its charge includes slaughter and processing of meat and poultry products. Substantially all (98%) hogs are slaughtered and pork processed under federal inspection. Some states maintain equivalent inspection systems; however, state inspected meat may not be shipped across state lines.

Inspection service during regular working hours is provided at no cost to processors. Second shift and overtime costs are billed to the user. However, proposals to transfer all inspection cost to processors are receiving serious consideration. Recent changes requiring the Hazard Analysis and Critical Control Points approach effectively move more of the cost of quality assurance to the processor as the FSIS role changes from continuous direct inspection toward verification of processor procedure.

All plants must develop, adopt, and implement a HACCP plan for each of their processes. Under HACCP, plants identify critical control points during their processes where hazards such as microbial contamination can occur, establish controls to prevent or reduce those hazards, and maintain records documenting that the controls are working as intended. This represents a major change in the inspection process. Generic models are available to assist small plants in implementation.

Export/Import Inspection/Certification

Export and import inspection and certification service is provided by Food Safety and Inspection Service for a fee to the exporter or importer. FSIS provides exporters with country specific certification based on the requirements of the importing country.

Financial Services

Equity financing for swine production has traditionally been provided from farm earnings and personal capital on family farms. Only recently have the very large farms accessed public capital markets or venture capital for hog production. Debt financing has been provided primarily by local banks and through the cooperative Farm Credit System. Feed dealers often provide credit for feed purchases. Credit for facilities and livestock is also provided by some hog marketing organizations such as the cooperative Michigan Livestock Exchange.

Contract production for others has been used by producers to reduce production risk and capital requirements. Generally, the proportion of capital that can be borrowed for facilities construction is higher than can be borrowed for operation. And, the maximum debt-to-assets ratio for producers under contract may be larger than for independent producers.

Marketing Services

The role of terminal stockyards and country dealers in hog assembly is much diminished. The share of assembly services provided by cooperatives for all livestock is small, about 13 percent. No separate estimate is available for swine. The larger producers ship direct to slaughterers and slaughterers maintain country buying stations to serve producers marketing less than truckload lots.

The Agricultural Marketing Service (AMS) of the U.S. Department of Agriculture provides a variety of marketing services to the pork chain. AMS oversees activities of the National Pork Board. The agency represents the Secretary of Agriculture with respect to the Pork Board and other similar promotion and research programs.

AMS also establishes grade standards for hogs and some pork products. Grading services are provided on a fee basis. Grading is voluntary and plays a minor role in the pork chain. Hog grades are used in price reporting, but in most cases, these are reporters' or buyers' judgment of grades rather than pricing on the basis of official grades. Processor brands are more important than grades for processed products.

AMS's Market News Service is its most visible presence in the hog and meat trade. A system of market reporting in cooperation with state departments of agriculture provides extensive market coverage for hogs, carcasses, and primal cuts of pork. Market News reports are widely disseminated and used in marketing decisions and as the basis for formula priced transfers under long term contracts between producers and processors. Market News depends on voluntary cooperation from producers, brokers, dealers, and packers for price information. Market News also provides daily and weekly estimates of federally inspected slaughter.

The National Agricultural Statistics Service (NASS) of the U.S. Department of Agriculture provides monthly data on slaughter by state for major states. NASS also provides quarterly estimates of inventory of hogs and pigs on farms, sows farrowing, and pigs saved. Inventories of hogs kept for breeding and market hogs by weight groups are reported separately. Farmers' intentions to farrow sows are also reported for the future quarter.

Transportation for live animals from farms may be via farmer owned trucks, contract haulers, or by buyer owned trucks. Pork and pork products are most likely to move in packer or processor owned trucks.

Research and Development

Research in the public sector ranges from basic genetics through pork product development. It includes work within USDA's Agricultural Research Service and that conducted by state agricultural experiment stations at Land Grant universities. State level research is supported by USDA, the states, and by grants from other sources including NPPC. The total annual expenditure of public funds on swine (including pork) research, including the NPPC grants, was about \$99 million in 1996.

Private sector research expenditure is unknown. Private research is conducted by genetics, feed, equipment, slaughter, processing, and drug companies. The balance has shifted toward private

research as public funding has not kept pace with inflation. Thus, there is a shift of knowledge power to the large private companies.

Construction and Facilities Manufacturing

There are no standards for livestock buildings other than local (state or county) building codes that are oriented to safety and that vary significantly from area to area. Building design and construction are determined by the owner. Specialized builders have developed designs and fine tuned their procedures such that they can often offer tested, turn-key swine production systems at costs comparable to costs of construction using farm labor. Large contractors usually adopt a single design to reduce costs and achieve predictable performance.

Systems of production continue to evolve. Three site production (farrowing, nursery, and finish) with early weaning, today's favorite, may be giving way to two site (farrowing, and direct movement of early weaned pigs to finishing facilities). Innovation by progressive producers often leads the pace set by research.

Human Resources and Training

Traditionally, farm labor has been provided by family members. Hired help was low skilled and low paid. As operations have grown, labor has become a significant problem for farm managers. Finding and retaining competent help is high on their list of concerns. Community colleges and vocational colleges recognize the need for higher skills in swine production and have added programs to meet this need. Swine producers are also realizing the need to provide better working conditions and better compensation to attract capable employees.

Training at other levels in the system is generally provided by firms for their own employees. Plant labor availability is a problem for slaughter firms. High turnover of employees is common and a significant proportion of immigrant labor in slaughter plants is the norm. Much of the labor is low skilled and low paid and working conditions are not appealing to many people.

Policy and Regulatory Environment

Government Role

Government's role in the U.S. pork chain is generally limited to policies regarding trade; regulation of practices to protect producers, consumers, or the public (environment), and research and education. Policies to control production and prices of feed grains had significant indirect effects on livestock production. However, this effect ended with the 1996 "freedom to farm" legislation which ended acreage controls and the system of target prices and deficiency payments to feed grain producers. As a result of this policy change, feed prices are expected to be more variable in the future.

Grain Inspection, Packers and Stockyards Administration

The previously independent Packers and Stockyards Administration was combined with the Federal Grain Inspection Service in 1994 to form the Grain Inspection, Packers and Stockyards Administration (GIPSA) of the U.S. Department of Agriculture. The basic mission of GIPSA is to

promote fair and competitive trading practices. In the case of livestock, the focus is on maintaining open and competitive markets for livestock and meat.

Market agencies that sell livestock on a commission basis are required to establish and maintain, for the benefit of livestock sellers, a Custodial Account for Shippers' Proceeds bank account. That is, funds received for the sale of livestock by an agent must be maintained in a separate account until paid to the seller. GIPSA audits these accounts.

The basic legislation requires full and prompt payment for livestock by slaughterers. This is assured by bonding of buyers and a trust that provides protection for the livestock seller.

GIPSA conducts investigations of packers, dealers, and order buyers to assure compliance with the law. Prompt payment, fair weighing and grading, and freedom from deceptive trading practices are the objectives. Semi-annual inspections of electronic devices used to purchase hogs on a carcass merit basis are conducted to ensure the accuracy and proper application of such devices.

Animal Welfare

Animal welfare, other than humane slaughter, is not a matter of law. Public concern is limited to a small but active minority. Good husbandry is the goal of most producers. However, the definition of good husbandry is subject to differences of opinion. Until now, the actions of the vocal minority has had little effect on pork demand and has not affected the industry appreciably. The animal industries are working together to educate the public about modern livestock production and to sensitize producers to the concerns of the public on this issue.

Environmental Regulation

Building codes and environmental regulation are state and/or local government matters. As such, they vary from very restrictive to almost non-existent for swine production facilities and manure handling. National clean water laws do affect the location and conduct of processing operations. Conflicts between rural residents and hog production operations are becoming more common. Odors and potential for groundwater contamination are central issues. These issues are also being used to further the agenda of those opposed to industrialized agriculture. Environmental regulation is a significant consideration in the location of new large swine production units. Areas of low human population are of necessity being favored for new large scale units.

The Pork Supply Chain

Structure

Genetics

The genetics stage (more often called the breeding stage) includes the maintenance of purebred lines and selection for improved performance of these lines as well as development of proprietary lines. It includes genetic research by firms engaged in breeding. The U.S. swine industry has evolved from dependence on relatively small family farm purebred breeders toward a major share of genetic seed stock being provided by large breeding companies. Traditional breeders operated in

local markets and developed local or regional reputations as breeding stock suppliers. Commercial hog producers selected grandparent stock from these operations to produce gilts for their own operations, followed various rotational breeding programs, or purchased gilts and boars from breeders or other producers.

As the size and sophistication of commercial producers increased, the scale of the seed stock suppliers had to increase apace. Herd health protection argued strongly for obtaining breeding stock from a single source in sufficient volume at one time to meet the producer's schedule for replacements.

Breeding companies such as PIC, DeKalb, and others have developed proprietary lines using generic material from a variety of sources. They have had the resources to support research and the development of premium lines. The very large producers use the breeding company genetics almost exclusively thus increasing the share of these genetics companies dramatically at the expense of the small breeder. Use of artificial insemination (AI) by the larger producers has reduced the demand for boars.

Commercial producers will increasingly use terminal cross breeding systems that use crosses of specialized sire and dam lines. Selection of each line will be based on the needs of that producer's market and production system. Further reduction in the number of smaller seed stock producers is virtually certain. Increased use of AI will hasten the process.

Breed associations have consolidated. One organization, National Swine Registry, now handles affairs for four breed associations. The organization has field agents across the corn belt, conducts shows and sales, and provides a system of genetic evaluation. Breeders and breed associations also participated in the development of evaluation systems.

Production

Production activity includes three stages; farrowing, nursery, and finishing. Farrowing includes maintaining the parent breeding herd (sows and boars), farrowing pigs, and keeping them to weaning. Weaning in modern production systems may be as early as one week of age but more commonly at two to three weeks. Weaned pigs generally are moved to a nursery facility until they reach 20 to 25 kg. At which time they are moved to a finishing facility to be fed to market weight. These activities may be at the same site as found in farrow-to-finish operations or at separate sites.

The structure of hog production operations has changed dramatically. The number of operations fell from 391,000 in 1985 to 157,000 in 1996, a decline of 7.9 percent a year during that period (Table 7). In 1995, approximately 28 percent of operations reporting an inventory of hogs were engaged in farrowing only, 35 percent were farrow-to-finish, and 37 percent were finishing operations only. There remains a large number of small farms accounting for only a small proportion of production. The 96,000 farms with inventories between one and one hundred represent only 3 percent of the inventory. The 4,880 operations with 1996 inventories of 2,000 or more hogs represent 51 percent of the inventory (Table 8). These official data, however, represent the units as reported to NASS and may include contract operations. That is, a producer contracting to house and care for animals owned by another firm is counted as a separate operation.

Table 7: Type of Hog Production Operations

Year	Farrow Only	Farrow to Finish	Finish only	Total
Number of Farms				
1985				391000
1986				346890
1987				331620
1988				326600
1989				306210
1990				275440
1991				253890
1992	70100	85950	84100	248700
1993	65200	81510	78500	225210
1994	59600	72080	76300	207980
1995	50300	63100	69300	181750
1996				157450

Source: USDA, National Agricultural Statistics Service, Hogs and Pigs.

Table 8: U.S. Number of Farms with Hogs and Percent of Inventory Held by Size of Inventory, 1996

Size Group	Number of Farms	Percent of Inventory
1-100	96000	3.0
100-499	36170	15.0
500-999	13350	15.0
1000-1999	7050	16.0
2000+	4880	51.0
Total	157450	100.0

Source: USDA, National Agricultural Statistics Service, Hogs and Pigs

A tally of the nation's largest pork producers by *Successful Farming* magazine indicated that 43 firms, each with 10,000 or more sows, accounted for approximately 30 percent of sows farrowing in 1996. In 1997 there were 50 firms with 10,000 or more sows that accounted for over 40 percent of the breeding herd (Freese). This sow count does not imply that all pigs produced by these firms remain under the same ownership for finishing. Operations vary from Premium Standard Farms, a totally integrated pork production and processing operation, to Alliance Farms Cooperative Association which produces feeder pigs for individually owned finishing operations. However, the very large pork production operations (marketing 50,000 or more finished hogs per year) accounted for about 13 percent of total production in 1993 (Grimes and Rhodes).

The organization of production operations has also undergone substantial change. Operations begun in the 1970s until recent years have been predominantly farrow-to-finish operations. New operations in the 90s have more likely included three-site production on an all-in all-out basis. That is, farrowing, nursery, and finishing operations are at separate sites and all of the animals are replaced at the same time. The large operations can operate on this basis with single ownership. Smaller

operators tend to specialize in one of the three operations relying on a network of producers to coordinate activities among the specialized operations.

Dramatic shifts in location of production are in process. The very large pork production operations and much of the recent expansion has been in areas outside the traditional corn belt hog production area. The first major expansion was in North Carolina. More recently, the expansion has been occurring in the West and Southwest as environmental concerns in traditional areas, and very recently also in North Carolina, have resulted in a much less friendly reception for large, confined operations in those areas. Texas, Wyoming, Colorado, and Utah have become more popular addresses. The North Central states remain the major hog producing area accounting for 68 percent of the December 1, 1996 inventory of market hogs (table 9).

Table 9: U.S. Inventory of Hogs on Farms and Head Slaughtered Percent by Region

Region	December 1, 1996 Inventory		1996
	For Breeding	Market Hogs	Head Slaughtered
North Atlantic	1.9	1.9	2.8
East North Central	21.5	20.4	16.8
West North Central	45.9	48.1	56.1
South Atlantic	18.2	19.5	15.9
South Central	8.3	7.4	5.6
West	4.1	2.7	2.7

Source: USDA, National Agricultural Statistics Service.

Slaughter/Processing

The set of activities included as slaughter/processing are discussed as two stages slaughter and processing. Conceptually, these are separate stages. However, as in the case of production activities, both may take place inside the same facility or may be conducted as separate businesses.

Slaughter is the killing and cutting of carcasses into primal cuts. In 1996, ten pork plants, each with over three million annual slaughter capacity, processed about 42 percent of U.S. hogs. The largest 28 plants (those with 1.5 million head or larger capacity) processed 80 percent of the hogs. A shift to much larger plants has occurred rapidly in the past decade. The largest ten packing firms account for about 84 percent of national capacity. The six largest multi-plant firms have the capacity to process 72 percent of the nation's hogs in twenty-four plants. The distribution of slaughter plants by size of plant is shown in Table 10 and daily slaughter capacities of the ten largest firms are shown in Table 11.

Today the standard scale of new plant is around 8,000 head per shift. Most of these plants will operate two shifts at 16,000 head per day or four million head per year. The largest plant now in operation is double that size for eight million head per year. New plants are expected to be built at a minimum scale of four million head per year. Plant location coincides generally with the location of hog production. At present, there is excess slaughter capacity in the North Central states, the traditional hog production area.

Table 10: U.S. Federally Inspected Hog Slaughter Plants

Size '000	Plants	Head '000	% Plants	% Head
<1	477	144.9	61.95	0.16
1;10	161	433.6	20.91	0.47
10;100	71	2739.6	9.22	3.00
100;250	16	2286.5	2.08	2.50
250;500	9	3376.7	1.17	3.70
500;1000	3	1975.1	0.39	2.16
1000;1500	5	7080.6	0.65	7.75
1500;2000	11	18893.8	1.43	20.69
2000;3000	7	16113.4	0.91	17.64
3000;3500	4	12861.9	0.52	14.08
>3500	6	25430.9	0.78	27.84
Total	770	91337.0	100.00	100.00

Source: USDA, National Agricultural Statistics Service, Livestock Slaughter.

Table 11: Estimated Daily Slaughter Capacity of 10 Largest Firms in 1997

Rank	Name	Plants	Capacity
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	Thorn Apple Valley	1	14.0
9	Indiana Packers	1	13.0
10	Lundy's	1	8.0
	10 Largest		344.9
	Total Capacity		411.8

Source: National Pork Producers Council.

Pork processing includes any processing beyond cutting to primal or wholesale cuts. Products include cured ham, canned ham, bacon, sausage, and products for the food service industry. Processing may be integrated with slaughter at the same site, owned by the same company as a slaughter operation but not operated at the same site, or performed by companies owning no slaughter facilities. Products of processing are varied including those for which pork is not the major ingredient. As such, it is a less well defined category and less information is available. Oscar Mayer, among the largest processors, has no slaughter operations. Eckrich and Foodbrands America are both owned by companies with pork slaughter operations. Slaughter by Sara Lee is dwarfed by their processing. Smithfield and Premium Standard have fully integrated slaughter and processing.

Distribution

Distribution includes activities associated with the transfer of products from slaughter and/or processing to the retail sector. The function may be performed or facilitated by independent merchant wholesalers, agents or brokers or by processors or retailers themselves. Merchant wholesalers accounted for 56 percent of wholesale grocery sales (all products) in 1992. Manufacturer's sales branches did 25 percent and agents and brokers 19 percent of sales (Connor and Schiek). The wholesale distribution structure is less concentrated than is pork processing.

Coordination

This section follows the pork chain downstream from genetics to retail with a focus on coordinating arrangements at each stage interface. Stages are defined by activities that could be separated by markets. That is, each stage produces a product and each stage could define the boundaries of a firm. Each stage transfer may be accomplished by a variety of means from open spot market to full integration of two or more stages within one firm.

Like the structure of the industry, coordination practices are in a state of transition. Generally, the change is away from spot markets to other arrangements. However, transfer pricing under emerging arrangements depends extensively on prices generated in the shrinking residual spot markets.

Genetics - Farrowing

As already discussed, the genetics stage includes the spectrum from relatively small purebred breeders to the major breeding companies. The majors command an increasing share of market—now exceeding 40 percent. The traditional breeders' product was grandparent stock, boars and gilts used by commercial producers to produce gilts for commercial production. In this case, the multiplier function was integrated by the commercial producer. In other cases, the breeder maintains the multiplier function and sells gilts and boars as commercial herd replacements. Open market transactions predominate for the traditional group. Shows and sales conducted by breed associations or coordinating agents facilitate transfers of grandparent stock.

The products sold by major breeders include great grandparent, grandparent stock, and parent stock. Thus, they are typically engaged to some extent in production of parent stock. Smaller producers are more likely the customer for parent stock from the integrated genetics-multiplier firm. Very large producers often integrate the multiplier function and buy grandparent or great grandparent stock from the genetics firm. These very large producers use the major breeder genetics almost exclusively. These relationships tend to be more in the nature of a contract extending over several years. A longer term relationship is considered necessary to assure the volume and timing of delivery of breeding stock that producers desire.

Pricing of breeding stock is typically negotiated as a premium over the value of market hogs. The exception is the sale of purebred stock at auction. The premium over market price depends on the perceived value of the genetics involved. Grandparent or great grandparent stock is priced to the producer at market plus a premium and a royalty on all gilts produced. The contract normally allows for sale outside the producer firm or network only with agreement from the breeder. The details of premium and royalties are negotiated on a case-by-case basis.

Genetics companies recognize that the ultimate value of their product lies in acceptance by consumers. Thus they work directly with downstream slaughter and processing firms to incorporate factors valued by consumers into the product. This achieves a level of communication that would be difficult to achieve by market price alone. Of course, such product attributes must be reflected in market hog pricing to be accepted by commercial producers. Major breeders' advertising reflects claims to be responsive to processor needs.

Small producers often buy replacement boars and gilts by negotiation in essentially a spot market from breeders or other producers. Large producers tend to be on a program that requires specific timing and an assured supply of exactly specified products. Thus, long-term arrangements for gilts and boars (or semen) priced by agreed formulas prevail in these cases.

Farrowing - Nursery - Finish

Separation of a nursery stage is a relatively recent development. While the nursery stage has been separated physically from farrowing operations in new large operations, in most cases it remains integrated with (or under contract to) the farrowing firm. The organization of these three stages has gone through two cycles of change. Prior to the major expansion of farrow-to-finish operations during the 1970s, feeder pig production was often separated from finishing operations. There was a major trade in feeder pigs at that time. The shift toward farrow-to-finish operations during the 1970s led to a much diminished trade in feeder pigs. The 1990s brought development of very large production units and technologies with separate but coordinated farrowing, nursery, and finish operations to attain significant improvement in herd health. The current wave of change further diminishes the independent production of feeder pigs.

Transfers from farrowing to nursery are typically integrated although nursery services may be provided by contract operations. Usually, title to the animals remains with the farrowing or farrow-to-finish operation. The new very large production operations typically operate the farrowing stage and often the nursery stage as company-owned operations. With the exception of Premium Standard Farms, which is totally integrated, these large farms contract for finishing with independent growers. Many smaller producers also contract for finishing when they have the capability of generating more feeder pigs than they have capacity to finish in their own facilities.

Pricing of open market feeder pigs typically follows closely the prices of finished hogs. Some auction markets for feeder pigs remain.

The role of cooperatives in swine production is increasing. For example, Alliance Farms, associated with Farmland Industries, is a cooperative (with hog finishers as members) to produce feeder pigs in volume and timing to fit 900-1,000 head capacity finishing operations. Other multi-function cooperatives have established feeder pig production units to supply their members or to supply contract production operations of their own.

Feed - Production

Traditional hog production in the North Central states was oriented around own-farm feed production. Feed preparation was typically on-farm using homegrown grains and either a supplement including the protein fraction or using a base mix with homegrown grains and soybean meal.

Manufacturers of supplements and base mixes sell directly to farmers or through dealers on a current market basis. However, if financing is provided by the feed company, the producer is required to buy from that supplier. Feed companies maintain producer loyalty by providing research information and often a records system to provide efficiency benchmarks.

Today's more sophisticated production technology has moved the industry toward off-farm feed preparation. The exacting requirements of phase feeding and split sex feeding and the advantage of pelleted feeds have diminished the attractiveness of on-farm feed preparation. Specialized hog producers find that dedicating their time to the hogs rather than grain and feed production is often more productive. Very large producers have sufficient volume to support their own feed milling operations at an efficient scale.

Feed companies, viewing the diminished share of independent producers, are actively promoting producer networks to exploit state-of-the-art technology. This role varies across companies and within companies depending on the needs of the customer. Generally, the networks span genetics to slaughter with an emphasis on cost control and producing hogs that command a premium at slaughter.

Finishing - Slaughter

One must recognize assembly as a function in the chain; however, it has become less and less significant as a separate operation. The traditional system of relatively small producers left a role for firms at this assembly level. Country hog markets, commission firms operating at central markets, and auctions played a significant role. Direct shipments from producers to slaughterers and slaughterer procurement through country-buying stations have diminished the role of livestock marketing firms. Remaining firms and cooperatives have become more closely associated with individual packing operations.

Coincident with the decline of a separate assembly function, hog marketing has moved from a largely spot market basis with live weight pricing to greater use of long term arrangements and rapid shift to carcass weight and grade pricing. The Chicago Mercantile Exchange futures contract has been shifted to a carcass based contract.

A survey of major slaughterers representing 86 percent of U.S. kill indicated that, in 1993, 87 percent of the hogs slaughtered by these firms were procured as spot market purchases. Sixty-eight percent were from deliveries to their packing plant or their own buying stations with only two percent acquired at terminal or auction markets and 16 percent purchased through dealers or order buyers. Only 13 percent was from long-term contractual arrangements with producers (six months or longer) or packer-owned production. In the same survey these packers were asked what their expected arrangements would be in 1998. Purchases from the spot market were expected to fall to 66 percent with a significant reduction in order buyer and dealer volume. Long-term marketing contracts were expected to grow sharply, increasing from 11 percent in 1993 to over 25 percent in five years (Hayenga et al.).

Informed observers indicate that the long-term contract proportion will have reached more than 35 percent already in 1997. Thus, the change has been more rapid than anticipated by the packers at the time of the 1993 survey. Approximately half the packers involved in long-term

arrangements in 1993 required a minimum volume and either a minimum quality of hog or specific breeding or genetics for producers involved in contract arrangements. Some went so far as to specify feed or nutrition programs and approval of facilities.

Contract terms vary widely. However, nearly all transfers are priced based on market quotations. Usually the base markets are as quoted by Market News Service of the U.S. Department of Agriculture. Window contracts set a range in which prices to producers vary with quoted markets. Outside that range the producer receives only a share of prices above that level or absorbs only a portion of the loss below the specified level. Very few contracts are fixed price or priced on a cost of production formula. Term of the contracts varies from a single production cycle to several years. A new evergreen contract is for a term of one to three years with the term renewed every day until canceled by one or the other of the contract participants.

The very large producers are almost invariably selling to packers under some long-term marketing arrangement. Access to markets (shackle space) is a major concern for these very large operations. Smaller producers are increasingly making use of cooperative marketing arrangements (such as Hog Inc.) that have no physical marketing facilities but simply act as coordinators of marketing for their members.

The drive for long-term contracts between producers and processors is from the producer side. Producers are apparently more concerned about market access than several of the major packers are about assuring a flow of hogs. While several of the slaughterers have programs for which genetics and/or feeding are specified, most of the contracts do not specify a specific line of genetics or feed use. The packers rely on their premium and discount schedules to encourage the production of desirable hogs. These schedules do not directly reflect eating quality of pork.

Slaughter - Processing

The nature of coordination arrangements between the slaughter and processing stages varies with companies and products. The range is from within company transfer from slaughter to processing at the same plant site to nearly all trades negotiated and priced on a day-to-day or week-to-week basis. When processing takes place at the same site, administered transfer is expected to be the rule. However, ownership of processing and slaughter operations by the same parent company does not necessarily mean that they are closely coordinated. Generally, the more customized the cuts, the more likely they are traded under some formula pricing arrangement.

Some processors are allied with one or a few slaughterers. In these cases, long term arrangements with transfer pricing by formula based on market quotes (usually USDA Market News) are the norm. These arrangements are usually informal agreements that continue indefinitely. Contracts are rare. Pricing formulas may remain unchanged from two months to two years. Coordination in these alliances is more likely to focus on cost of the processor's final product than on price of the standard cut. Alliances of this type are in the minority. Lack of trust between slaughterers and processors is cited by processor buyers.

Other processors avoid alliances and negotiate for supplies on a day-to-day basis. When the processor's specifications deviate from the standard commodities, they identify several slaughterers capable of meeting the specifications and negotiate within that group for supplies. A group of related

cuts may be priced by formula with the base price negotiated on a day-to-day basis. Clearly the system depends on these negotiated trades to supply the quotes the allied participants rely on for transfer pricing.

A survey of pork market participants, including, retailers, by Sparks Companies, Inc. for American Meat Institute in 1996 found that 50 percent of trades were negotiated. Prices for hams and trimmings were more often negotiated than those for butts and ribs. Other pricing arrangements were dominated by formulas against market quotes.

Slaughter - Retailer

Fresh pork sales to retailers are predominantly negotiated day-to-day. Alliances between slaughter and retail are rare. There are some slaughterer brand programs that tie the retailer and slaughterer but these are rare and, in most cases, involve only a portion of the retailer's pork volume. Informal interviews with buyers indicate a lack of trust as the major factor limiting closer relationships. At this time, slaughterers appear to be more interested than are retailers in developing closer relationships at this level. More complete data available from retail sales analysis is now being exploited to only a limited extent.

Fresh pork sales of primal cuts from slaughter to food service firms are under arrangements similar to those with retail food stores. However, much of the transfer to food service is from the processing stage or through food service distributors.

Processor - Retail

Processor to retail food stores transfers of branded products are typically on a list price basis. That is, packaged products are offered to the retailer on a fixed price, take-it-or-leave-it basis. Case ready fresh meats are transferred to retail under indefinite-term, formula-priced arrangements.




Relationships between processors and food service organizations range from fixed price on highly processed items to day-to-day negotiation for commodity or near commodity items. Generally, the relationships between processors and food service firms are closer than those with food stores. In many cases the products are produced to the customer's specifications including exact portion sizes. Transfers of these products are priced by formula with the supplier committed to supply whatever the buyer orders.

Pork chain linkages are illustrated in Figure 2. Letters indicate the type of link at each stage interface and lines show the span of arrangements across stages.

Figure 2 U.S. Pork Chain Linkages

Stage Linkage C=contract V=verbal O=ownership
M=market

Stage	Linkage	C=contract	V=verbal	O=ownership	
Genetics	M	C	VA		
Farrowing	O	C	M	O	
Finish	M	C	V	O	
Slaughter	M	O	O	V	O
Processing	M	O	O	V	O
Distribution	M	V	O	V	
Retail/Food Service					

 Very Common
 Common
 Not So Common

Performance of the Pork Supply Chain

Consumer Demand

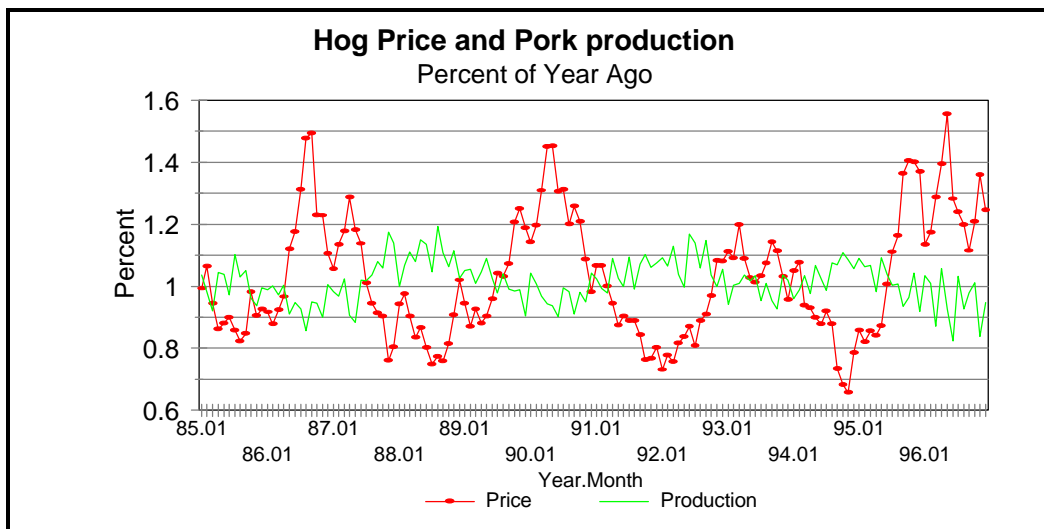
U.S. pork production is basically limited by demand. Despite environmental problems in some areas, pork production could be increased easily by a substantial amount without pressuring resource availability. The industry has not inspired consumers effectively. The stated goal of NPPC to make pork the major U.S. meat of choice by 2000 appears to be unattainable. Recent gains in tonnage have been more for export than for domestic consumption. There is little in the current picture to indicate a change from the pattern of the past 20 years.

Poultry continues to gain against beef and pork. One of the arguments has been the lower price for poultry. However, the retail price index (1982-1984 equals 100) indicates that poultry prices have increased more rapidly from the base period to 1996 than either pork or beef prices. In 1996 the poultry index stood at 152.4, pork 148.2, and beef 134.5, all increasing less than all food at home at 154.3. Even though dietary cholesterol is less a concern today than 10 years ago, health concerns appear to continue to favor poultry. The high level of acceptance of poultry in food service and product innovation by poultry firms have been major factors in this gain.

Seasonal and Cyclical Variation

U.S. pork production has been cyclical with just under four years from peak to peak in the cycle. The famous hog cycle appears to persist. Low production periods result in significant idle production and processing capacity. It also results in a boom and bust cycle for hog production profitability. In the past there was significant entry and exit from the industry based on prices at the time the decisions were made. It remains to be seen whether the emerging larger fully confined production operations will exhibit as much quantity variation as has been experienced in the past. Contraction of production has been the result primarily of producers leaving hog production permanently. Expansion, in most cases, represents new or expanded operations. Year-to-year changes in pork production and hog prices, illustrated in Figure 3, provide little evidence that the tendency to cycle is decreasing. A comparison of the standard deviation of monthly hog price and pork production for the periods 1980-1989 and 1990-1996 indicates no significant difference

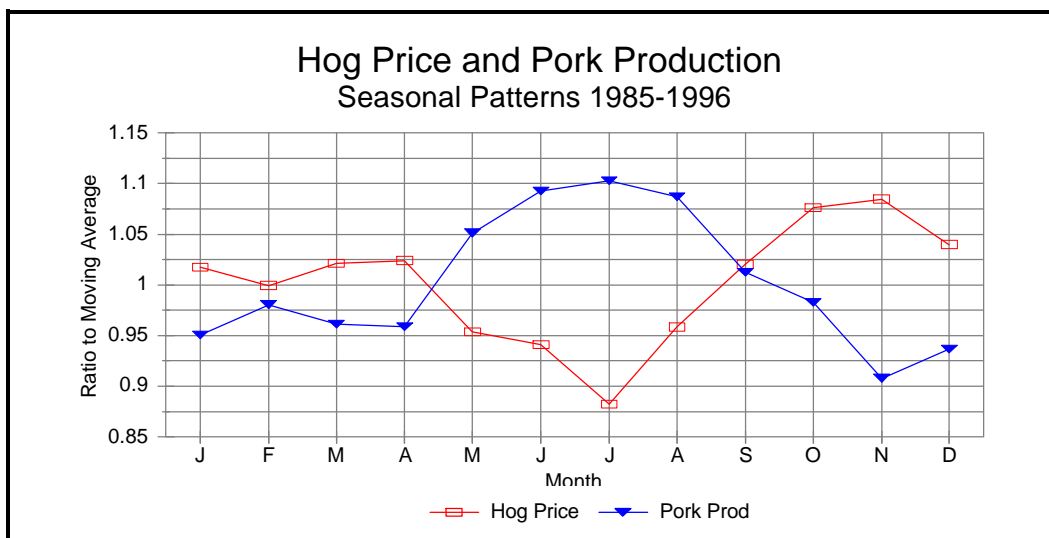
Figure 3



between the two periods. The coefficient of variation (standard error as percent of mean) of monthly seasonally adjusted hog price 1985 through 1996 was 13.1 percent. The same measure for seasonally adjusted pork production per day was 8.9 percent.

There is also substantial seasonal variation in pork production and prices (Figure 4). The price seasonal for the period 1985-1996 varies from a November low of 90.8 percent of the 12 month average to a high of 109.2 percent in June. The production per day seasonal varies from 88.2 percent in July to 108.5 percent in November. The pattern of seasonal price variation indicates a production-driven rather than a market-driven system. That is, production is high when price is low. Cost of production patterns may explain part of the variation in prices; however, it does not negate the idea that the pork system is production driven rather than market driven. Both the production cycle and seasonal pattern indicate that significant gains in efficiency may be attained through closer coordination of production and marketing.

Figure 4



Production Cost

One cannot characterize production costs for the whole of the U.S. in a meaningful way. However, one may infer something about cost from prices. Table 12 shows average prices for hogs in Iowa and Minnesota on a live weight basis from 1985 through 1996. It also provides an estimated cutout value of a hog carcass based on the yield and price of primal cuts and retail values of pork. These averages provide some notion of the price that reflects the cost plus necessary profit to induce production. These data suggest that costs of production and processing have changed little in nominal terms during the period. Clearly the same cannot be said for the slaughter to retail margin which has increased over 30 percent.

Table 12: U.S. Hog and Pork Prices 1985-1996

	Hogs ¹	Cutout ²	Retail	Farm to Cutout	Cutout to Retail
Dollars per 100 Kg					
1986	112.52	152.23	393.32	39.70	241.09
1987	113.80	153.00	415.40	39.20	262.40
1988	97.09	131.33	404.34	34.24	273.01
1989	98.63	133.64	403.11	35.01	269.47
1990	121.96	163.14	468.66	41.18	305.52
1991	109.55	147.75	467.12	38.21	319.37
1992	94.86	128.68	436.53	33.82	307.85
1993	101.63	137.10	435.67	35.47	298.56
1994	88.25	126.30	436.62	38.05	310.32
1995	93.36	132.23	429.46	38.87	297.22
1996	117.73	159.59	487.00	41.87	327.41
Average	103.97	139.67	427.87	35.71	288.20

¹ Iowa-Minnesota barrows and gilts

² Carcass value based on yield and cuts prices

Source: USDA, Agricultural marketing Service and Economic Research Service.

Hog production cost records maintained by Iowa State University provide a reasonable estimate of costs experienced by typical commercial producers in that relatively low feed cost state (Table 13).

Table 13: Iowa Hog Production Costs

Average of Records 1996 and 1985-96		
		Average
	1996	1985-96
Return to Capital Percent	30.27	28.64
Pigs per Female per Year	16.60	15.36
Whole Herd Feed Efficiency	3.50	3.74
Feed Price \$ per 100 Kg	20.59	14.98
Hours Labor per 100 Kg	1.26	1.47
Cost \$/100 Kg		
Feed	71.87	55.95
Operating	12.28	11.28
Depr, Tax, & Ins	5.89	6.10
Interest on Fixed & Oper Cap	6.70	6.84
Labor	11.27	10.05
Total Cost	107.89	90.19
Non-feed Cost	36.13	34.28

Source: Iowa State University.

These records also suggest little change in costs other than feed, which was unusually high in 1996. Hog production has been profitable for the average producer and very profitable for the better than

average. Progress in breeding, nutrition, and facilities has offset inflation in input prices. Capital costs in these data reflect partly depreciated facilities and might not cover replacement buildings and equipment.

Table 14 illustrates the costs of a large farrow-to-finish operation using all known technology and new facilities. These data show why the very large producers have been attracted to the industry. If these cost estimates are correct, it is clear that it will be very difficult for the traditional producer to compete.

Table 14: 1200 Sow Farrow to Finish Production Budget

	Per Litter			Cost per	Cost per
Direct Charges	Unit	Quantity	Price	Litter	100 Kg
Corn	M.T.	2.418	95.66	231.29	21.79
Soybean Meal	M.T.	0.653	214.95	140.40	13.23
Other Feed	100 Kg	1.134	79.37	90.00	8.48
Total Feed				461.69	43.49
Veterinary & Medicine	\$			12.00	1.13
Fuel and Utilities	\$			40.00	3.77
Marketing	\$			23.40	2.20
Miscellaneous	\$			5.00	0.47
Dead Animal Disposal	\$			0.75	0.07
AI Costs	\$			0.99	0.09
Total Direct				543.83	51.23
Indirect Costs		Investment	Charge		
Market Inventory	\$	107.61	8.63%	9.29	0.87
Breeding Inventory	\$	66.69	56.04%	37.37	3.52
Equipment	\$	480.57	19.69%	94.62	8.91
Buildings	\$	465.86	13.40%	62.43	5.88
Land	\$			0.51	0.05
Labor	\$			48.24	4.54
Management	\$			32.50	3.06
Total Indirect				284.96	26.85
Total Cost				828.79	78.08
Non-feed Cost				367.10	34.58

Source: Purdue University.

Labor

Regulations including worker safety, working hours, overtime pay, and rights to organize and bargain collectively apply to all levels of the pork sector except that working hours are more flexible for farm labor. This flexibility applies regardless of the type of farm ownership. That is, the very large corporate owned farm is accorded the same treatment as the family farm. This treatment of labor on the so called *factory farm* is the subject of some controversy. Questions are also being raised about the long term health effects of work in confined livestock operations.

Availability of labor for slaughter and processing has been a concern for these operations. Typically, turnover is high and there has been increasing dependence on immigrant labor. In many cases, the small towns in which the processing plants are located are ill equipped to provide housing and other services for these unfamiliar new workers. There is a realization that, at both the farm and processing levels, jobs will have to become more attractive to retain qualified workers. Hourly labor costs will likely increase relative to the average in other employment. Whether this will result in higher labor costs per unit of output depends on the rate of change in labor saving technology.

Farm Structure and the Environment

While, in principle, farm structure and environmental concerns are separate issues, they have become closely related. There are people who are genuinely concerned about the potential for contamination of both ground and surface water from animal manure. Very large confined production units hold the potential for larger single event problems than would be the case for dispersed small units. Any spill from a large unit attracts attention. Others argue that the restrictions placed on the design and policing of large units provides assurance that, for any given number of hogs, the pollution is less from the large units than for dispersed small units that are not subject to the same controls.

Water quality has also been used as an issue by rural non-farm residents whose major concern is air quality (odors) affecting their quality of life. Residential development in rural areas near population centers has become a fact of life for many agricultural areas. Hogs are not regarded as good neighbors. Traditional hog producers who see the very large hog producer as a threat to their way of life have joined the non-farm residents in opposition to the large units using air and water quality to make their case.

Zoning laws are local (county and in some cases township) and are used to prevent development of the large units in many cases. They will continue to affect location of hog production. States may also have permit requirements for units over a specified size. There are advocates for national standards to reduce the problems created by varying local standards. NPPC favors steps toward greater reliance on self regulation.

Pressures for Change and Implications

Drivers of Change

Demand

Major factors affecting domestic food demand are population, income, price, attitudes, and other demographic factors (Connor et al.). Of these, population is the least dynamic. Increasing at less than 1 percent per year, it represents a steady increase in overall demand but contributes little to explain changes in the pattern of food demand.

Real (inflation adjusted) per capita consumer income has been increasing at about 1.5 percent per year since 1980. This has stimulated increased per capita expenditure on food of 0.3 to 0.5 percent per year. The increase represents primarily an upgrading of the purchase rather than an increase in total quantity purchased. Higher incomes have accelerated the trend toward use of food prepared outside the home and the packaging of services with food products convenient and quick to prepare at home. Possession of household appliances such as microwave ovens has also affected the form in which food products enter the home. Increasing incomes enable consumers to indulge higher order preferences such as taste, variety, convenience, and the way the food is produced.

Food prices have generally increased at about the same pace as other consumer goods from 1985 through 1996. Prices for food away from home increased slightly less than those for food at home. Meat and poultry prices increased slightly less than all foods. Fresh fruits and vegetables prices increased at twice the pace of all foods. Thus, while one must recognize prices as major determinants of demand, recent changes have not been cause for major changes in U.S. food consumption patterns. In fact, the greater price increase in prices of fresh fruits and vegetables is associated with increased use. The perception of value of fresh and healthfulness is apparent here.

Demographic characteristics other than population and income have accounted for additional changes in food demand. Households are becoming smaller, and smaller families are in style. Many are dual career families. These characteristics have increased the proportion of meals away from home and the pattern of meal preparation at home. The population is aging suggesting reduction in per capita food use. These factors also suggest the importance of convenience.

Attitudes toward foods are the most important drivers of change. And, the pace of change is increasing. Family meals have given way to more casual meal patterns. Meals are eaten away from home more often. Lifestyles demand convenience for home prepared meals as well. There is more desire for variety and adventure in eating. Nutrition and health are more a part of the shopping decision. Health receives more attention both from the standpoint of the relationship of diet to health and the potential for food borne illnesses. The same aversion to any risk (real or perceived) concerning food also operates to prevent the use of irradiation that could be used to virtually eliminate the threat of pathogens in food.

Productivity and Technology

Progress in animal nutrition and development of methods to improve herd health have had major impacts on hog production costs and on the organization of production. Significant cost advantages accrue to large production units that are capable of employing state-of-the-art technology. Automation of greater shares of slaughter and processing operations have reduced unit costs and favored large plants. Progress in quality measurement has made possible more accurate quality assessment of hogs and more feedback to producers and breeders. Information technology will facilitate the management of supply chains.

Porcine somatotropin and repartitioning agents capable of modifying the growth and composition of swine hold the potential to speed change in the direction preferred by consumers. However, their use has not been approved and such approval does not appear to be likely in the near future. Even if approved, it is not clear that their use would be accepted by consumers.

Government Regulation and Policy

Law and the courts appear to have moved further in the direction of placing responsibility for any outcome of the use or misuse of any product on the supplier. The supplier is held liable for any adverse effect associated with a product almost without regard to how the product was used. The perception by the public that risk from foodborne illness is significant and unacceptable suggests that more regulation related to the safety of the food chain is likely.

State and local regulation of confined animal production systems, stimulated by the reaction of the public to the building of very large units, has increased dramatically. These regulations relate primarily to protection of water and air quality. They include specified distances from existing residences and manure storage and disposal methods as well as the nutrient loading of land used for disposal.

The shift of U.S. farm policies away from supply management toward a free market for grains and oilseeds is expected to result in more variable feed prices. Land diversion and non-recourse loans to support prices and facilitate carrying inventories to support and stabilize grain prices are no longer a part of policy. This increases the risks associated with hog production.

There is growing concern among the public regarding the welfare of animals in confined production operations. As yet, these concerns have not resulted in regulation of production practices. There are no signs that such regulation is likely in the next few years.

Resources

Space for production, though not in fact limiting, is limited in many areas by regulation. Nevertheless, the increased regulation has not limited the potential for expansion of pork production in the U.S. These regulations do increase costs and affect location of production. Feed resources are not limiting and feed ingredient costs are expected to be competitive in world markets.

Low unemployment and continued economic growth in the U.S. does mean that wage levels and working conditions typical of pork production (farm and beyond) are insufficient to attract the quality of labor needed for today's technology. This technology requires better educated workers than has been typical in the past.

Capital is limited for the beginning smaller producer. Access is easier for the producer under a contract that reduces price risk and provides access to management assistance. Some very large production organizations have been able to access equity capital markets directly. This means that, for the industry as a whole, equity and debt capital are not effectively limiting.

Implications

The foregoing pressures, particularly those from changes in demand, imply the need for significant changes in the organization of the pork sector. Consumer desires, enabled by increasing real income, require a greater diversity of products and products with (or without) specific attributes. Access to international markets also implies changed product specifications which may require changes upstream to genetics. Many of these product changes will not be such that they can be produced from traditional raw materials. To the extent that consumers and new markets also specify production practices they increase the need for chain differentiation.

Greater flexibility will be required in the pork sector to meet changing consumer demands and to react quickly to changing conditions in international markets. Product cycles are becoming shorter and the time required to make changes will have to be shortened as well. The chain must be organized to identify trends as they develop and to communicate the changes needed upstream to effect change at the appropriate stage or stages. Data being generated at the retail level must be analyzed in a timely fashion and communicated to those who can take action.

The continuing shift from meals prepared at home to meals eaten away from home or purchased fully prepared for use at home implies further moves toward tight product specifications including portion control and emphasis on uniform eating quality. It implies closer working relationships between food service organizations and processors. New product and process development will likely be more closely coordinated with the food service organizations. Products to access a larger share of the food service market, particularly fast foods, are keys to increasing the share of pork in the animal protein market.

The primary implication of the drivers of change in the pork sector is that a higher degree of coordination from genetics to the consumer will be required for the U.S. pork sector to increase its share of the domestic meat market and to expand sales in a world market. Responsiveness will need to be enhanced both with respect to timing and the delivery of products meeting customer specifications.

Effective competition for the consumer's dollar also requires that the system operate efficiently. This requires optimization of the full chain rather than a focus on cost at each stage. That is, the objective should be to minimize system cost rather than minimizing cost at each stage. While it may be possible to effect product customization at the processing level, it may well be more efficient to make those changes at the genetics or production levels in the chain.

Risk management is closely related to cost control. Customers, particularly in the food service markets, desire stable prices. Access to capital is improved with improved risk management. However, changes in support policies and the fact of a more open world market increase the risk exposure substantially at the production levels. A systems approach will allow for measures to reduce or manage risks more effectively than attempting to accomplish this on an individual stage basis. Inventory and transportation management are integral parts of system efficiency. Retailers, both food stores and food service, view inventories as expense and will more and more insist on just-in-time-delivery of products. Optimization of logistics may require greater use of horizontal coordination measures. At present, the most concentrated stages in the pork sector are slaughter and processing. These firms focusing on a national or international market may not always have plants well located to serve all portions of a particular market. Thus, in addition to maintaining relationships in the vertical dimension, efficient servicing of some of these market segments may be best accomplished by alliances of firms at the same stage. That is, a processor with operations in only one area of the country may find it to their advantage to arrange co-packing contracts with other processors closer to the final customer. Similarly, sizing of slaughter plants has been dominated by plant cost efficiencies and may not have taken into account the full costs of live animal transportation.

Changing markets imply an emphasis on managing the full chain from genetics through retailing based on the demands of the customers. Quality assurance has become a much more significant factor. This includes both quality control in the sense of product attributes as well as the assurance that products are safe for consumption. Joint liability with respect to safety places a new emphasis on management of the supply chain. A shift in regulations from complete reliance on government inspection to government monitoring of private quality programs places additional responsibility on the private sector. New procedures and arrangements will be necessary to assure that all participants are doing their part. Japanese pork markets have required the development of chains that will be needed to meet developing domestic demands as well. Size of cuts, meat composition, and taste characteristics that are needed to meet specifications of a significant share of the pork market will require specific genetics, feeding, and processing that are unlikely to be achieved with open market coordination. Measures needed to assure the safety of pork reaching consumers (and ability to determine liability for any problems) are, perhaps, more urgent reasons for additional chain control.

Capability to Respond

The foregoing discussion identifies directions that the pork sector should consider to be competitive for domestic and international consumers' food budgets. The question at this point is whether the sector is capable of responding to these challenges and how well supporting industries and government further these efforts. Only a very general assessment can be offered on the basis of information available for this study. One must recognize that the United States represents a vast market and a market which, today, depends primarily on commodity pork produced by a sector that is coordinated largely by open markets. Clearly, not all of the sector participants need change in the same direction. Commodity pork will continue to play a major role for years to come. There is the potential for managed chains to be put in place to serve specific demands within the scope of one slaughter or processing firm for whom the major share of business is commodity pork. However, it is recognized that the system is not now delivering enough of the quality and consistency of products that will gain market share in the future (Morgan et al.).

The following table (15) summarizes judgements as to whether the industry, supporting industries, and government are now positioned to favor (+), discourage (-), or are neutral (0) with respect to appropriate sector response to perceived challenges. The industry appears to be process and product oriented. Change to accommodate the pressures on the system must be led from within the industry. The industry has demonstrated flexibility to meet changing demand and excels at cost control. Quality assurance is receiving attention at all stages. The shift from food store to food service markets depends on product development, some of which require adjustments at more than one stage in the system. Responsiveness and risk management depend on greater vertical coordination that is limited by a lack of trust. The supporting infrastructure, including nutrition, health, equipment manufacture, financial markets, and logistics are available to support needed industry change if identified by the industry. Government action is, at best, neutral and more often seen as impeding change. Government's role in providing assurance of wholesome foods can facilitate change.

Table 15: Capability to Respond

	Industry	Supporting Infrastructure	Government
Product and process development	0	0	-
Flexibility to meet changing demand	+	0	0
Shift from food store to food service	+	0	0
Responsiveness and customization	0	0	-
Cost control	+	+	-
Risk management	0	+	-
Logistic optimization	-	+	0
Reengineering the chain	0	0	0
Chain quality assurance	+	0	+
Chain management	0	0	0
Knowledge and education	0	0	0
Vertical coordination	+	0	-

Conclusions and Implications

The U.S. hog-pork sector benefits from low cost feed supplies and, compared to other major producers, excels in the exploitation of scale economies. A tradition of individual entrepreneurship and freedom to compete in an open market are also advantages in a more open world market. Nevertheless, there remains room for improvement.

A major factor limiting the development of customer oriented chains within the sector is the lack of trust among people at adjacent stages. Adversarial rather than cooperative relationships predominate. This lack of trust impedes the development of linkages that might enhance value or provide for risk and profit sharing without full integration or contracts that give one party virtually full control. The alternative for the chain organizer is to take control using ownership or hard contracts to accomplish the needed coordination.

Carcass weight and grade pricing from finish to slaughter has been effective in providing feedback in only the lean and size dimensions. More complete evaluation and feedback are needed to achieve the conformity and quality many customers desire. Eating qualities are in the conversation

but incentives are not in place for producers to change. Full genetics-to-customer coordination occurs for only a small fraction of pork production at this time.

Pork producers (National Pork Producers Council) have taken an active role to discover customers' desires and in promoting quality control. However, until those considerations are reflected in producer payments, the pace of change will be slow. Producers recognize the problem and are capable of appropriate response. Partnering is in the vocabulary but far behind in action.

The U.S. is a low cost pork producer but the chain is not fully optimized. Stage optimization is present and logistics leave room for improvement. There are disconnects in information flows. Scale economies are, to a large degree, exploited at the slaughter and processing levels but flow variations suggest room for improvement in capacity use. Apparently non-optimal seasonal and cyclical production variations remain. Animal-to-animal variation in size and conformation impede plant automation.

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