PURDUE AGRICULTURAL ECONOMICS REPORT

MAY 1998

Food System 21: Gearing Up for the New Millennium - Part I

Introduction

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*—winner of a Gold Award for editing from the Agricultural Communicators in Education. Congratulations to Laura Hoelshcer, PhD, Editor, Agricultural Communications Service, for this accomplishment.

In this and subsequent issues we will provide summaries of five key chapters of that book: international trade, consumer demand for food, the hog/pork sector, the beef sector and the grains and oil seeds sector. These summaries will present the "Key Questions & Responses" section, of each chapter which provides a synopsis of the most important issues discussed in that chapter of the book.

You may or may not agree with our analysis. We encourage you to read the complete analysis in *Food System 21: Gearing Up for the New Millennium* which is available for $29.95 from:

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International Trade

Philip Abbott, Thomas Hertel, William Masters, Philip Paarlberg, John Sanders, and Wally Tyner

Recent events in agricultural markets confirm the increasing importance of international trade and other forms of internationalization. When international demand is strong, as in 1995-96, or when there are significant production shortfalls elsewhere, world prices rise, the United States responds with greater exports, and so farm income rises. When demand weakens or surpluses occur here and overseas, export earnings falter, and so does farm income.

Some analysts believe that another watershed has now been reached, that food shortages, not surpluses, will characterize future agricultural markets, and that a freer, more open trading system will evolve, leading to more competitive, global markets. This chapter explores these perceptions and highlights recent events and emerging issues which will condition future evolution and behavior of international markets.

Key Questions & Responses

- **Will the major trends shaping U.S. agricultural exports change soon?**

  New destinations and new products have emerged and will continue to dominate trade trends. Potential demand for agricultural products is greatest in Asia and will be the strongest in those countries where economic performance is the strongest and where population is large. Growth markets may emerge, then recede, however, as income improvements no longer stimulate increased food demand.

In This Issue

➤ **Will the trend of increasing high-value and processed food product trade continue?**

There is little reason to believe that the trend toward greater trade in higher value and processed agricultural products will reverse. Improvements in the logistics of delivering processed foods, meats, and perishables overseas have made competition in the food industry global. Importing countries will increase domestic production capabilities, especially for meat, so that feedstuffs trade should expand rapidly, as well. Firms will also increase globalization efforts via foreign direct investment, a strategy which has been more utilized than trade in the past.

➤ **What will determine the extent to which U.S. agricultural exports to Asia continue to grow in the future?**

Continued growth in agricultural exports to Asia depends on continued growth in their non-agricultural exports. Therefore, any increase in anti-Asian protectionism in the U.S. likely would lead to a lower growth in U.S. agricultural exports to this region.

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Purdue University
Cooperative Extension Service,
West Lafayette, IN

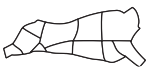
➤ **What about food needs in poorer countries?**

There will continue to be unmet needs for food in parts of the world (especially South Asia and SubSaharan Africa) and even in regions of the successful countries where food demand is growing. Income distribution and effective demand remain the key factors.

Understanding seemingly divergent trends in world agricultural markets requires understanding that the same forces skewing the income distribution in the United States, China, and elsewhere are leading to "dual" world agricultural markets. High-income consumers worldwide will demand specialty products in niche markets, which can become quite large and valuable to agribusiness firms. Persistence of poverty will concern some governments, which may intervene in commodity trade to stabilize domestic markets and insure adequate food supplies for a broader set of citizens. Thus, high-value trade is likely to continue to grow and will be more stable than commodity trade.

➤ **Does U.S. foreign aid have any impact on agricultural exports?**

Continuation of dietary transitions toward greater meat consumption depends on income growth at the bottom, and hence on whether U.S. and other foreign aid continues to make growth-enhancing investments in Africa and South Asia.



➤ **How will GATT and the WTO actually be implemented?**

In many countries GATT offers have been set so as not to constrain agricultural policy setting. Those domestic policy concerns will remain paramount, so we should look to these domestic reforms, not to GATT, to see how trade policy will evolve in the future. Pressures will continue, especially from agribusiness, for trade policy reforms and more transparent rules governing trade. Rules, hence non-tariff trade barriers, are more important than tariff levels in determining trade outcomes.

➤ **Will an Agricultural Mini-Round in 1999 move toward further reforms, and where?**

This is unlikely, because it is impossible to negotiate reforms of agricultural policy without balancing concessions against gains in other areas. Many of the key issues for a 1999 Mini-Round, such as state trading, are areas where the Uruguay Round failed to make progress.

➤ **Will regional integration expand the roles of trading blocks at the expense of multi-lateral negotiations?**

Regional agreements have always been more important to agribusiness, because they define more completely the rules under which trade occurs. Thus, there is more pressure for trading blocs, and they may be easier to negotiate. An important concern is that the formation of regional blocs at the expense of multilateral agreements could lead to greater, not less, protection.

➤ **Will entry into GATT/WTO put constraints on important non-members, such as China?**

We believe that domestic policy concerns will dominate evolution of agricultural trade policy, and China is no exception. While there may be some reduction in the extent of self-sufficiency, leading to increases in imports, GATT is not important enough to cause China to give up control of her food policy in the name of free trade. China's latest offer to WTO reflects its desire to maintain self-sufficiency in grains.

➤ **Will reform in the Former Soviet Union and Eastern Europe bring more exporters or importers to world markets?**

Food consumption in this region is already at levels found in wealthier developed countries. Income

growth following successful reforms will not lead to a surge in food demand, but will open up new niche markets for higher value products. Watch for bulk commodity exports from this region.

➢ **How will possible integration between the European Union and Eastern Europe affect the evolution of these markets?**

Integration with the European Union could be important in determining the U.S. share of these markets, but the EU cannot afford to implement its current farm policy in Eastern Europe. Either there will be substantial reform in EU agricultural policy, or Eastern European countries will join under different conditions for agriculture.

➢ **What are the implications of the new concerns for environmental protection, food safety, and animal and worker welfare?**

These issues will prove impossible to negotiate in multi-lateral fora, and domestic policy concerns will dominate. Any political agreement reached in GATT will have little substance. But concerns with the environment, food safety, and animal and worker welfare will be important forces shaping domestic policy, and so will indirectly affect trade.

➢ **How will the role of the private sector evolve?**

Firms may be well ahead of governments in establishing trading rules through such institutions as ISO 9000 and ISO 14000. Global firms are ahead of governments in pursuing freer trade and establishing transparent rules governing trade. This behavior by firms is likely driving governments more quickly toward liberalized trade.

➢ **How will the reforms embodied in GATT and in domestic reforms such as the new U.S. Farm Bill affect market stability?**

One of the hopes of the GATT round was that freer trade would bring about greater stability in international markets. Trade policy will insure that demand growth does not pace significantly ahead of supply potential. Increases in supply will depend on market incentives and on public and private investment in research. Domestic market stability remains an important objective of many countries. Policy implementation will seek to maintain some isolation from the uncertainty of world markets. Thus, many countries will continue to export their instability. Since exporters like the U.S. under GATT have eliminated many stabilization mechanisms, more unstable markets will be the rule.

➢ **How will governments respond to increased volatility?**

Farm income in the United States is still dependent on international demand. So with the recent reforms of U.S. agricultural policy, farm income may become more volatile. Public concern for a safety net for agribusiness will be less for an industrialized agricultural sector than it has been for an agriculture based on family farms. Thus, international market forces will revive some of the old policy debates.

Hog/Pork Sector

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

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 are the focus of this chapter.

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. 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 it in the future. Increasingly, the capital markets are allocating funds to those who exhibit superior performance in 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 use 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—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 consumer's 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.

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Tuesday, July 7

1 pm . . . . Gary/Mark Hite . . . . . Northwest Howard County
3 pm . . . . Ted/Terry Merrell . . . . . Northwest Howard County

Wednesday, July 8

8 am . . . . Robert/Bryan Kirkpatrick . . East Howard County
10 am . . . Scott Smith . . . . . North Tipton County
12 noon . . Lunch and outlook presentation at Smith's
1:30 pm . . Salsbery Families . . . . . North Tipton County

Economics of Variable Rate Planting by Yield Potential Zones

Jess Lowenberg-DeBoer, Extension Economist

Varying plant populations within fields is an old idea that has been given new life by the availability of GPS technology. Intuitively, it makes sense to reduce plant populations on soils that have lower yield potential. From the investment cost perspective, variable rate planting is relatively inexpensive, especially for a producer who already has invested in GPS. A variable rate planter controller sells for about $3500-$4000. Precision technology automates the process and reduces switching errors.

Numerous agronomic studies have considered variable rate planting. Pioneer Hi-Bred studies indicate that optimum seeding rates do not vary much across a wide range of soil and yield conditions in the Cornbelt. They also suggest that, while seeding rates below the optimum can reduce yields, higher than optimum seeding rates carry little penalty.

"The general conclusion is that variable rate seeding by yield potential zones has profit potential mainly for farmers with some low-yield-potential land (<100 bu./a)."

But intuitive appeal and low investment cost do not necessarily generate profit. The objective of this analysis was to examine the profitability of variable rate planting for corn, using available information on crop response to plant populations, estimates of crop responses by yield potential from Pioneer Hi-Bred agronomists, and a spreadsheet model. The results indicate that variable rate seeding by yield potential zones is profitable mainly for farmers with some low-yield-potential land (<100 bu./a).

Manual variable rate planting systems have been around for about 20 years, but they failed to catch on because they depended on the alertness of the operator. Farmers who used manual systems often say that they worked when the operator was fresh, but that as fatigue crept in, they would often forget to switch populations. All the gains from lower populations for the low-yield-potential areas could be lost if a few rounds were made at the lower population in higher yield areas.

Pioneer agronomists concluded that variable rate seeding may be profitable on farms with some areas with yield potential below 100 bu./a. Data from a three-year study in Kentucky shows a modest return to variable rate planting on fields with some areas below 100 bu./a yield averages. Some farmers have reported success in variable rate planting by soil type, instead of yield potential.

Methods - The approach was to develop spreadsheet budget examples that estimate returns to various seeding rate strategies and then to vary certain prices to determine the sensitivity of results to assumptions. The Pioneer Hi-Bred population response functions were used to estimate corn yields because they are the best available for Cornbelt conditions. The focus was on corn because no soybean population response functions are available. The analysis was only of varying response by yield-potential zone. Plant population responses by soil type are not available.

One of the key questions raised by agronomic studies is how the changes will be determined if planting rates are varied. Accurately mapping yield potential is, in itself, a major problem. It was assumed that the yield-potential zones are relatively small, irregularly shaped, and interspersed, so that management by field or other unit would be difficult. It was assumed that yield-potential zones are accurately mapped. For simplicity, this study also assumed that the proportions of the corn area with high, medium, and low yield potential were known and that variable rate equipment could accurately change populations given a map of the zones. The zones were defined as:

- **High:** over 180 bu./a expected yields
- **Medium**: between 120 and 140 bu./a expected yields
- **Low:** under 100 bu./a expected yields

Results for three strategies for determining plant population are reported here:

- **Uniform seeding** to achieve a population of 28,000 plants/a at harvest - The control to which other strategies are compared.
- **VRT, agronomic rule** - Variable rate seeding based on Pioneer agronomic recommendations.
- **VRT, economic rule** - Variable rate seeding based on the economic criteria that the marginal value of the additional product be equal to the marginal cost of the additional input in every management zone.

The plant populations for the variable rate strategy using agronomic recommendations were: low potential, 18,000; medium potential, 28,000; high potential, 30,000. For

the variable rate strategy with the economic decision rule, the plant populations were: low potential, 20,000; medium potential, 26,000; and high potential, 30,000. Price assumptions included: corn at harvest, $3/bu.; corn seed, $67/bag; dryer fuel, $0.50/gal.; variable rate controller and monitor, $3500; interest rate, 10%. Other assumptions included: 1000 acres of corn planted; to allow for germination and other problems the planted populations should be 10% higher than desired population at harvest; and the useful life of the planter controller was 5 years.

In the examples, only the seeding rate was determined site specifically. All other inputs were held constant. Larger gains are to be expected in an integrated system which manages several inputs site specifically.

To keep the example simple, the baseline farm was assumed to have only two yield-potential zones: 50% high-yield-potential land and 50% low-yield-potential land. Scenarios were also developed with a 50/50 mix of high-and medium-yield-potential land and a 50/50 mix of low-and medium-yield-potential soil. Other scenarios included varying seed price from $50 to $110 per 80000 kernel bag and changing the variable rate equipment cost from $2000 to $8000 per farm. The baseline scenario assumed that the producer's only investment was the variable rate planter controller and monitor. The sensitivity testing considered the case of producers who must also purchase GPS units, computers, or other equipment to implement variable rate planting.

Results and Discussion - Consistent with the agronomic studies, variable rate planting shows economic advantage on farms with some land with under 100 bu./a yield potential (Table 1). The benefits vary with the proportion of low potential soil, but are of similar magnitude for mixes of high-and low-or medium-and low-potential land. Benefits occur for a very modest proportion of low-yield land. Both variable rate strategies show small positive returns at 10% of land being low yielding.

The benefits are highest when a small part of the farm has high-potential soil. In the baseline example, when 90% of the farm is low yield potential (10% high yield potential), the gain from variable rate is around $4/a for both variable rate strategies. With the variable rate strategies, the source of economic benefits depends on the proportion of low yield land. When proportion of low yield land is small, yield gains provide most of the benefits and seed savings are small. When the proportion of low yield land is large, the largest source of benefits is seed savings.

If the farm has a mix of medium-and high-productivity land, the cost of variable rate planting is greater than the yield or seed savings benefits (Table 1). Higher seed cost increases value of site-specific variable rate management but does not change the general management advice. Farmers with a mix of high-and low-productivity land may benefit from variable rate seeding at any seed cost in the range from $50 to $110 per bag. Farmers with a mix of medium-and high-yield-potential soil are better off with uniform rate planting.

Similarly, a higher investment cost for variable rate equipment reduces the benefit, but the farmer with a mix of low-and high-yield-potential soil still shows positive returns, even with an $8000 investment on 1000 acres of corn. The farmer with a mix of medium-and high-potential soils does not show positive returns from variable rate even at a $2000 investment cost.

Conclusions & Implications - The general conclusion is that variable rate seeding by yield potential zones has profit potential mainly for farmers with some low-yield-potential land (<100 bu./a). The examples indicate that profitability does not depend on the productivity of the other land in the mix, as long as it is substantially higher than that of the low-productivity soil. Variable rate seeding can be profitable for mixes of high-and low-or of medium-and low-yield-potential soils. Farmers with a mix of medium, and high-potential land are better off with uniform rate seeding. Sensitivity tests indicate that variable rate seeding is potentially profitable when the proportion of low-yield land is as low as 10%. Results are not particularly sensitive to seed cost or variable rate investment cost. Overall results suggest that variable rate seeding may be most valuable in areas on the fringe of the Cornbelt where some of the low yield potential soils are farmed.

Table 1. Net Gains from Variable Rate Seeding

Percentage of the Farm Low or Medium Yield Potential	Variable Rate Agronomic Recommendations[1]	Variable Rate, Economic Decision Rule[1]
	$/a/yr	
Low Yield Potential[2]		
10%	0.47	0.50
50%	2.16	2.32
90%	3.85	4.15
Medium Yield Potential[2]		
10%	-0.05	0.00
50%	-0.44	-0.22
90%	-0.83	-0.43

1 Compared to seeding for a uniform population of 28,000 plants/a.

2 Remainder of the farm is high yield potential.

Note: A more detailed report of this analysis is available in "Economics of Variable Rate Planting for Corn," J. Lowenberg-DeBoer, Dept. of Ag. Economics Staff Paper #98-2, Purdue University, West Lafayette, IN, March, 1998.

Manufacturing in the Indiana Economy

Steven McCoy, Graduate Student, and Kevin McNamara, Professor

Indiana's favorable geographic location, large labor pool, and manufacturing-friendly state and local government policies have been instrumental in attracting and retaining manufacturing firms (Houin and McNamara, PAER, Nov. 1997). Employment growth in the Indiana manufacturing industry from 1983 to 1995 is evidence of this success. Indiana's manufacturing employment growth rates are particularly impressive when compared to the national economy.

The U.S. economy grew by 34 million jobs from 1983 to 1995, a growth rate of 29%. The Indiana economy grew by 773,000 jobs, a growth rate of 36%. While a similar rate of economic growth occurred at both the national and state level, performance in the manufacturing sector was quite different. Nationally, manufacturing accounts for 13% of total employment and grew by 2% from 1983 through 1995. In Indiana, manufacturing accounts for 27% of all jobs and grew by 18% over the 1983-1995 period.

Manufacturing is not only a substantial source of employment but is an important source of revenue for the people and state of Indiana as well.

Of the $132 billion Indiana Gross State Product, 31% or $40 billion was attributable to the manufacturing sector (1994 Survey of Current Business). At the national level, manufacturing contributed 18% or $1.2 trillion of the Gross Domestic Product of $6.5 trillion in 1994. This article begins with a comparison of trends in national manufacturing sectors to the same sectors in Indiana over the 1983-1995 period. The manufacturing economy is broken into 20 standard industrial classification SIC (Standard Industrial Classification Manual) sectors for this paper . The second section discusses Indiana manufacturing employment shares, and the paper concludes with a description of location quotients and what they mean in the context of the Indiana manufacturing economy.

U.S. and Indiana

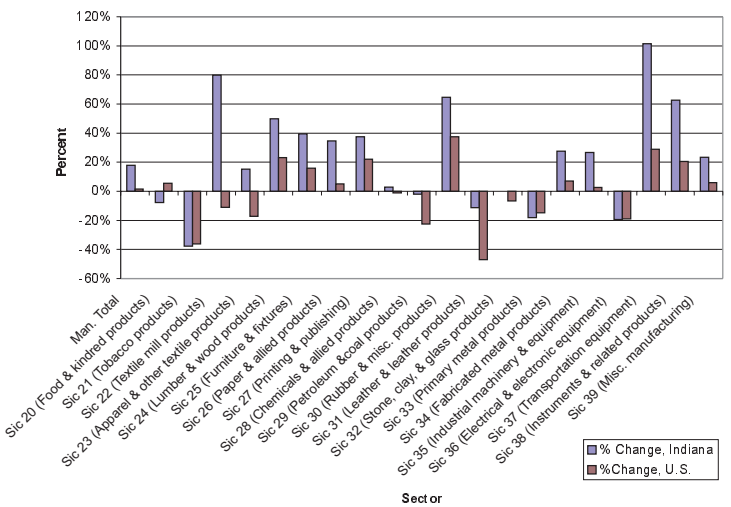
Total employment in the U.S. was 149,445,500 in 1995, of which 19,218,600 workers were in the manufacturing sector. Employment in the manufacturing sector increased by 2% from 1983 to 1995, while total U.S. employment increased by 29%. The U.S. manufacturing sector employed about 13% of the national workforce, down from 16% in 1983. In 1995, the largest manufacturing sectors in terms of national employment were industrial machinery and equipment, food and kindred products, printing and publishing, and electrical and electronic equipment. Continued restructuring of the manufacturing sector since 1983 resulted in an increase in employment levels in 11 of the 20 manufacturing sectors (Figure 1). A manufacturing sector is defined by its SIC code. Firms producing similar products are assigned the same SIC code. The SIC system enables economic data to be compared at the county, state, and national level.

Manufacturing employment in the transportation equipment and rubber/rubber products sectors increased by 37% and 29%, to 980,100 and 969,800 jobs, respectively, an addition of 484,000 jobs. Printing and publishing materials manufacturing added 308,300 jobs to the national economy over the same period. Other sectors with positive changes in employment levels added 819,800 jobs to the U.S. economy over the 1983 through 1995 period.

Over the same period employment in the leather and leather goods sector declined by 47% to 114,000 jobs in 1995. Employment in tobacco products and petroleum and coal products manufacturing decreased by 36% and 23%, respectively, a loss of 65,700 jobs. Other sectors with losses in employment had 815,600 fewer jobs.

The manufacturing industry in Indiana has experienced sustained economic growth since the manufacturing downturn in the early 1980s. Employment in the manufacturing sector increased by 18% between 1983 and 1995, from 590,569 to 696,239 jobs (Figure 1), in contrast to the 2% growth rate at the national level. Changes in the structure of the

Figure 1. Percent Change in Manufacturing Employment; Indiana and U.S., 1983-1995



Source: REIS, BEA, Sept. 1997

Indiana manufacturing sector mirrored national trends. Employment change rates in Indiana are larger than national rates in all but two manufacturing sectors, petroleum and leather products. Indiana trends differed from the nation's in the food and kindred products, and apparel and other textile products sectors.

Indiana manufacturing employment in 1995 accounted for 696,239 of 2,549,312 jobs, representing 27% of Indiana employment, up from 23% in 1983. Manufacturing of transportation equipment, textile mill products, rubber and miscellaneous products, and instruments and related products exhibited the largest percentage change in employment.

The transportation equipment sector was the largest manufacturing employer in 1995, with 91,480 jobs, a 102% increase from 45,578 jobs in 1983. The second largest sector in terms of manufacturing employment was the industrial machinery and equipment sector, with 75,919 employees in 1995, a 23% increase from 59,969 in 1983. Employment in the electrical and electronic equipment manufacturing sector, the third largest manufacturing employment sector, was 68,642 in 1995, 19% less than in 1983. The primary metal products manufacturing sector lost 18% of its jobs as the number of employees went from 82,569 to 67,627. In 1995, the rubber sector employed 56,535 people, an increase of 65% over 1983 employment. Employment in the stone, clay, and glass products manufacturing sector was the only category to remain constant throughout the 13-year, period with 19,326 jobs.

Indiana Manufacturing Shares

Indiana firms in the manufacturing of transportation equipment employed 91,480 people in 1995, a 14% share of manufacturing employment in Indiana and a 3% share of total Indiana employment in 1995 (Figure 2). Industrial machinery, electrical and electronic products, and primary metal products manufacturing each accounted for more than 10% of the manufacturing employment, and together they employed 229,438 workers, more than 9% of all those employed in the state. The manufacturing of tobacco, textile, and leather products sectors accounted for 3,558 jobs, less than 1% of manufacturing employment in 1995.

Indiana Location Quotients: A Measure of Concentration

The location quotient (LQ) is a measure of the degree of an industry's concentration in a state or region in comparison to the general economy. LQ values below compare manufacturing shares in the Indiana economy to national shares. The LQ is defined as:

$$LQ = \frac{Percent\ of\ state\ employment\ in\ \text{sector}\ X}{Percent\ of\ national\ employment\ in\ \text{sector}\ X}.$$

The LQ indicates whether a particular industry is more or less concentrated in the local economy than in the national economy. When an LQ has a value of one or more, the specified local sector has the same or a larger employment share as the same sector in the national economy. When an LQ is less than one, the sector's employment share is smaller locally than in the national economy.

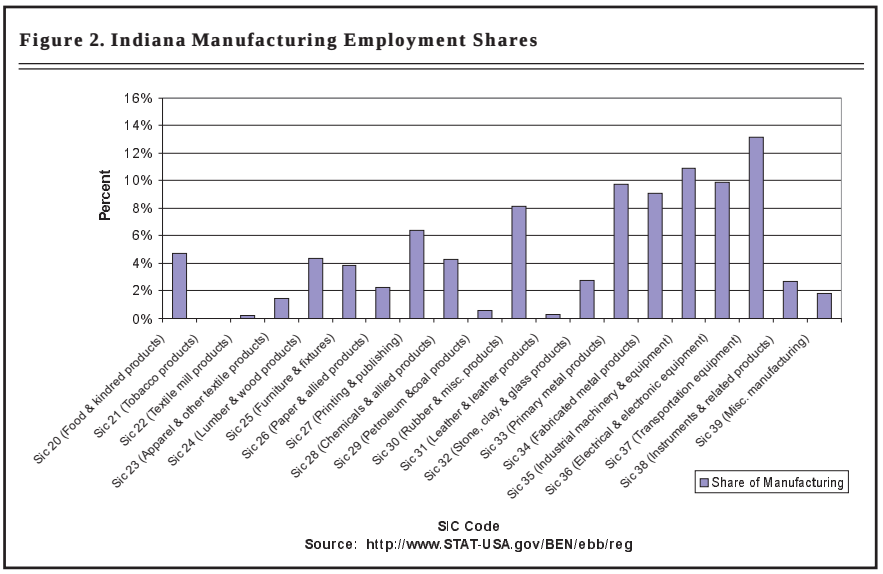
Manufacturing is concentrated in the state's economy, as LQs for Indiana manufacturing sectors (Table 1) suggest. LQ values between .8 and 1.2 are interpreted as the manufacturing sector having the same concentration as the national economy. LQs greater than 1.2 suggest the state has a greater concentration of the industry, while LQs below .8 suggest a lower concentration than in the national economy.

LQs for 10 of the 20 manufacturing sectors are greater than 1.2 . LQ values of 4.18 and 4.16 in SIC 33 (Primary Metal Products) and SIC 37 (Transportation Equipment), respectively, indicate strong concentrations in the Indiana economy. SIC 25 (Furniture and Fixtures) and SIC 30 (Rubber and Misc. Products) have LQs of 2.18 and 2.53, respectively, suggesting concentration in these sectors.

SIC 21 (Tobacco Products), SIC 22 (Textile Mill Products) and SIC 23 (Apparel and Other Textile Products) have LQs of .06, .08 and .46, respectively. These industries have little presence in the Indiana economy as compared to the national economy. LQs for the other 13 manufacturing sectors indicate the sectors have similar or slightly larger concentrations in the Indiana economy than in the national economy.

Location quotients also were calculated with the number of establishments (Table 1). The LQ gives an idea of the relative size of Indiana establishments in that sector compared to the size in the national economy. LQ values for the primary metal products sector are 4.18 (employment) and 2.19

Figure 2. Indiana Manufacturing Employment Shares



Source: http://www.STAT-USA.gov/BEN/ebb/reg

Table 1. Location Quotients for 2-Digit Manufacturing Sectors in Indiana, 1995.

Sector	Location quotient (employment)	Location quotient (establishments)
Sic 20 (Food & kindred products)	0.85	0.86
Sic 21 (Tobacco products)	0.06	0.42
Sic 22 (Textile mill products)	0.08	0.28
Sic 23 (Apparel & other textile products)	0.46	0.40
Sic 24 (Lumber & wood products)	1.48	0.99
Sic 25 (Furniture & fixtures)	2.18	1.32
Sic 26 (Paper & allied products)	0.97	1.25
Sic 27 (Printing & publishing)	1.15	0.92
Sic 28 (Chemicals & allied products)	1.26	1.08
Sic 29 (Petroleum &coal products)	1.17	1.24
Sic 30 (Rubber & misc. products)	2.53	1.77
Sic 31 (Leather & leather products)	0.85	0.89
Sic 32 (Stone, clay, & glass products)	1.47	1.33
Sic 33 (Primary metal products)	4.18	2.19
Sic 34 (Fabricated metal products)	1.88	1.49
Sic 35 (Industrial machinery & equipment)	1.57	1.48
Sic 36 (Electrical & electronic equipment)	1.83	1.05
Sic 37 (Transportation equipment)	4.16	2.16
Sic 38 (Instruments & related products)	0.99	0.82
Sic 39 (Misc. manufacturing)	1.18	0.83

Source: Calculated from data from http://www.STAT-USA.gov/BEN/ebb/reg

(establishment). This suggests that Indiana establishments are larger by employees per plant in this sector than establishments in the national economy.

Summary

Indiana has a strong manufacturing economy, employing 27% of the state's workforce in 1995. Manufacturing employment increased by 18% from 1983 to1995, to 696,239 jobs. Fifty-three percent of employment in Indiana manufacturing occurs in five sectors; transportation equipment; industrial machinery and equipment; primary metal products; electrical and electronic equipment; and fabricated metal product products. In general, the Indiana manufacturing economy has mirrored national trends. Of the 20 manufacturing sectors in Indiana, 13 had positive growth rates, while 6 had negative growth rates. Location quotient values suggest that out of the 20 manufacturing sectors in Indiana, 10 had larger shares in the Indiana economy than in the national economy, 7 had shares similar to the national economy, and 3 had smaller shares.

Indiana Farm Fence Law

Gerald A. Harrison, Extension Economist

Indiana law still makes it a duty for landowners outside corporate town or city limits to separate their land from that of their adjoining neighbor by a partition fence (IC 32-10-9-2). The law states that unless there is a recorded agreement to the contrary, a landowner shall build the right one-half of the line fence determined by facing an adjoining neighbor's property.

A "lawful" partition fences should be "hog tight," and capable of holding sheep, cattle, mules, and horses.

A landowner is compelled to help build and maintain a lawful line fence, even if it is only to keep his neighbor's livestock from trespassing.

If a neighbor refuses to construct or maintain his share of a line fence, after 20 days, the landowner can seek the assistance of the township trustee. But first, the land-owner seeking assistance must build or repair his share. Once notified by the trustee with the cost of the project, if the reluctant neighbor does not perform the work in 20 days, the trustee is required to have the work performed.

Indiana law requires a railroad to construct and maintain the entire fence along a right-of-way sufficient to prevent livestock from getting onto the tracks if the landowner has enclosed the other three sides of the area bounded by a rail right-of-way.

When a railroad fails to build or maintain a necessary fence, the adjacent landowner may build or repair the fence. If the landowner has given notice, and followed other procedures in the law, he may be reimbursed for his costs.

Existing fences may not be on the boundary line as Indiana law requires. A fence may have been erected under an erroneous assumption about the location of the line.

An adjoining neighbor may acquire a strip or segment of land from an adjoining landowner. With a law suit that makes a successful claim under the doctrine of *adverse possession*.

More information is in *Indiana Farm Fence Laws*, EC 657, available at county Purdue Cooperative Extension Service Offices or by calling the author at the toll free number, 1-888-398-4636. On the Internet, you may locate EC657 at <www.agcom.purdue.edu/AgCom/Pubs/EC/EC-657.html>. You may go directly to the Indiana fence law at <www.state.in.us/legislative/ic/code/index.html>.

The Asian Economic Crisis: Does It Matter to U.S. Agriculture?

Philip L. Paarlberg, Associate Professor

People keep asking whether the economic problems in Asia matter to U.S. farmers and agribusiness. The growth in Asian markets for U.S. agricultural products is often cited as the reason for the growth in U.S. agricultural exports during the mid 1990s. The expected continued expansion of those markets is identified as the source of future gains for U.S. agricultural exports. Will the economic problems and disarray in that region of the world have negative impacts on U.S. agricultural exports this year and in the future?

The short answer is "yes." The economic chaos and deflation in Asia will adversely affect the U.S. agricultural export performance. Farmers' concerns are justified. The adverse effects will vary greatly by commodity, with high-value-added agricultural product sales more adversely affected than bulk commodity sales. Exports of feedstuffs will be hurt more than exports of wheat. How badly U.S. agricultural exports will be affected and for how long cannot be determined at this stage. That depends upon how well nations in Asia face and deal with their problems.

The extent of the economic problems varies by country. Thailand, Indonesia, Korea, and Malaysia are the most seriously affected. Singapore, the Philippines, and Hong Kong have also experienced significant troubles. Japan is less adversely affected at this point, though that nation has experienced little economic growth throughout the 1990s.

For most nations in the region, the origin of the problems lies in their banking and financial sectors. Banking and financial practices which contributed to the rapid growth of recent years also created the conditions which led to the collapse. Loans were made, not on the basis of profitability of an investment, but rather on the connections of the individual or for political gain. This resulted in a massive misallocation of capital, excess capacity, large volumes of non-performing assets for banks and securities firms, and losses for manufacturing enterprises. Rather than allow banks and security firms to go bankrupt, more money was provided to cover the non-performing loans. By spring 1997, it was clear that the financial structures of Thailand, Indonesia, Malaysia, the Philippines, Singapore, Korea, and Japan were weak. The issue was when would the structures begin to collapse and how strong would be the decline.

The disclosure in the fall of the inability of several large firms and banks to cover their obligations and the subsequent closure of some banks and brokerage houses triggered the collapse. The immediate response was the sharp depreciation of these nations' currencies on world markets as well as severe drops in their stock markets as domestic and foreign investors tried to save the money invested in these economies. From January 14, 1997 to January 14, 1998 the Indonesian currency fell by 67 percent, and the Korean currency fell by 49 percent. Incomes have fallen and so have consumer purchases. Purchases of foreign goods have been even more sharply curtailed. As of mid-January, reports indicate that U.S. agricultural exports have slowed as these nations are unable to make additional purchases or have canceled earlier commitments. In some cases, like Indonesia, transactions must be paid in full in cash with hard currencies.

These nations have been large and growing importers of U.S. agricultural exports. During 1996, Southeast Asia plus Japan and Korea purchased nearly 19 billion dollars worth of U.S. agricultural exports, or over 30 percent of our agricultural exports. Since around one-quarter of farm income comes from exports, purchases by these nations represent 8 percent of U.S. farm income. The importance of these markets to U.S. farmers and agribusiness varies by commodity. In the case of meats, fruits, and vegetables, Asian nations are critical because U.S. exports of these products are concentrated in those nations. Asian nations are also important buyers of U.S. feedstuffs, like oilseeds and feed grains, and rice. Since U.S. wheat exports are more geographically dispersed, exports of that commodity will be less severely affected.

To reduce the adverse effects of the economic slowdown in Asian economies, the United States and the international community have taken several steps to assist Thailand, Indonesia, and Korea. International agencies, like the International Monetary Fund, have pledged aid in excess of 100 billion dollars. The intention of this aid is to isolate the economic damage to the Asian nations while providing the funds necessary for stabilizing and restoring these economies. The United States Department of Agriculture has provided 1 billion dollars in credit guarantees to Korea to finance purchases of U.S. agricultural goods. Other nations in the region have also received credit guarantees. Canada and Australia have provided financing for agricultural trade as well. The loans from the international community are linked to domestic banking and economic reforms such as policy liberalization. Such reforms are intended to prevent the conditions which led to the crisis in the first place. Malaysia has indicated that it will not accept outside help. Japan has proposed a short-term stimulus package for its economy.

The extent to which the Asian economic problems will affect U.S. agriculture and the duration of the effects depend on a number of factors. A reduction in the fiscal year 1997/98 U.S. agricultural export forecast of 58.5 billion dollars is expected, and exports for the next few years will likely be slower than otherwise would have been the case. A reasonable forecast at this point is that U.S. agricultural exports will be 0.5 to 1.5 billion dollars lower than if the problems had not occurred. How quickly Asian political leaders come to grips with the economic problems is the major factor determining the severity and length of the economic effects. If Asian leaders recognize and deal with the problems in a direct manner, the adverse effects will be milder and of a shorter duration. Delay in dealing with the problems risks a longer period of stagnation and greater risk of infecting other nations. To this point there has been a tendency to blame outsiders, like currency speculators, for the problems rather than recognizing that the crisis is home grown. The financial assistance provided by the United States, other nations, and the international community is valuable in softening the impacts and preventing them from spilling over to other nations.

"Concern is justified because the economic problems of these nations, which are critical to U.S. agricultural exports, are negatively affecting U.S. agriculture."

In the longer run the fundamental conditions of high rates of saving and an educated work force in these nations support economic growth, and these nations should return to positive economic growth and upgrading diets. This will be positive for U.S. agricultural exports, especially products like meats, fruits, and vegetables. However, it is also unlikely that these nations will resume the extremely rapid economic growth seen over the last 15 years, because some of that growth was linked to using unsound financial practices. It is more likely that they will emerge from the present crisis with strong, but more sustainable rates of economic growth. Agricultural exports by the United States might not see the spectacular rises of the past, but will benefit from more moderate, but sustainable, growth.

Concern is justified, because the economic problems of these nations, which are critical to U.S. agricultural exports, are negatively affecting U.S. agriculture. The extent of the problems and how long the adverse effects will be felt is unknown. Much depends on decisions taken by Asian leaders. The support offered by the United States and the international community, while costly, is critical in dampening the spread of the negative impacts to other economies.

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Gerald A. Harrison
Department of Agricultural Economics
1145 Krannert Building, Room 630
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