Department of Applied Economics

ECONOMIC AND LOCAL GOVERNMENT IMPACTS OF THE MINNESOTA SWINE INDUSTRY

Final Research Report
Prepared for the
Minnesota Pork Producers Association

April 1, 2000

By

Dr. William Lazarus
Associate Professor and Extension Economist

Dr. George W. Morse
Professor and Extension Economist

Diego Platas
Graduate Research Associate
Department of Applied Economics

Steffanie Guess-Murphy
Graduate Research Associate
Department of Applied Economics

College of Agricultural, Food, and Environmental Sciences

University of Minnesota

Sponsored by
Minnesota Pork Producers Association
Center for Urban and Regional Affairs, University of Minnesota
College of Agricultural, Food, and Environmental Sciences, University of Minnesota

Acknowledgements

The authors wish to thank the Minnesota Pork Producers Association, the Center for Urban and Regional Affairs at the University of Minnesota and the College of Agricultural, Food, and Environmental Sciences for financially supporting this project.

We also are grateful to a number of colleagues that assisted in the development of this research. In particular we wish to thank Dr. Inhyuck Ha, who developed the integrated econometric/input-output model used to estimate the local government fiscal impacts, and William Crawford, who helped us pre-test the mail survey. We also wish to thank Dr. Robert Morrison, who reviewed drafts of this report. The authors, however, remain responsible for any remaining errors or omissions.

Table of Contents

List of Tables

List of Figures

I. Introduction

Concerns about odor and the environment continue to make it difficult for pork producers to obtain approval for new facilities. Local communities, the state and industry attempt to weigh these concerns against the economic benefits of industry expansion. The Minnesota Pork Industry Review (1994) described the economic importance of the pork industry at that time, but is now outdated. While more recent reports are available for the USA and other states, specific information on the importance of the Minnesota pork industry at the state and local level are lacking.

The Minnesota Pork Industry Review report did not estimate the changes in local government taxes and expenditures stemming from the pork industry or provide a methodology for estimating the economic and local government impacts of specific swine installations at the county level. These estimates could be very useful in local discussions about new permits.

Related research on different sizes of pork producers (Otto, Lawrence and Swenson, 1996) has been criticized on several methodological grounds. This study advances this area of work by incorporating survey data on the geographical spending patterns for different types and sizes of pork producers in several different types of local economies. It also incorporates Minnesota data into the production functions and considers the impact of differential survival rates.

Another important aspect of the economic impact of the Minnesota pork industry is the impact on corn and soybean prices received by crop farmers. The 1994 Minnesota Pork Industry Review did not consider these impacts. It is possible that recent pork production expansion may have increased grain consumption enough to exceed local supplies and to increase local the grain price basis, but the impact has not been examined systematically. This study uses local elevator corn price data to examine this possibility.

Accurate information on the economic and local government impacts of new swine facilities would help local and state governments make decisions about these proposed new facilities. This project provides new information on these impacts and the methodology for making these estimates.

II. Research Objectives

The overall objective of this research project is to evaluate the economic and local government impacts of the pork industry and recent changes in the industry. The specific objectives are to:

1) estimate the economic impacts of the pork industry on employment and income both within the pork industry and in supply industries which depend on the pork industry;
2) estimate the changes in local government expenditures and revenues due to economic changes stemming from the pork industry; and
3) characterize any year-to-year changes in local corn price patterns around Minnesota that might be correlated with changes in pork production.

III. Review of Prior Research [i]

This section reviews the research that relates to the research objectives outlined above. The review is limited to those articles that focus on the establishment of the economic and fiscal consequences to the community, region, or state resulting from pork production. Three main areas of focus are used to categorize the literature. The first subsection will review articles dealing with the multiplier effects of pork production. Next, literature dealing with purchasing patterns of pork producers will be discussed and the relationship between farm size and local purchasing are examined. Under this subsection, two streams of research will be reviewed: a) articles dealing with types of supplies and b) articles dealing with regional purchase coefficients. The next subsection will review the literature dealing with the impact of pork production on local government expenditures and revenues. Finally, a prior study on factors relating to changes in local corn prices is discussed.

3.1 Estimates of the Multiplier Effects of Pork Production

A number of studies have used regional input-output models to trace the multiplier effects of the pork industry on suppliers and consumer industries. As shown below, none of these studies have correctly examined the differences that stem from different sizes and types of production. All of the earlier studies assumed generic purchasing patterns rather than collecting specific data by type and size of operation and by location of the farms. Likewise, none of the earlier studies considered the expected value of the impacts after factoring in the long-term survival rates of different sizes and types of operations. The strengths and weaknesses of each of the earlier studies are examined below.

Jahae and van Staalduinen (1992) examined the economic impact of a proposed 1,200-sow unit on the economy of Redwood County, Minnesota. They used the IMPLAN model and assumed the regional purchase patterns given by the model.

An integrated input-output/econometric model was used by Iowa State University economists to estimate the impacts of different sizes of pork operations. These are reported in two articles (Otto, Orazem, and Huffman, 1998; and Otto, Lawrence, and Swenson, 1996). Thompson and Haskins (1998) provided a critique of these articles. All three are reviewed in depth here.

The two articles by Otto, et al. were based on the same research, originally reported in the 1996 Pork Industries Economic Review, published by the National Pork Producers Council. Starting with data from Purdue University on the costs of production and time required on farrow-to-finish operations of 150, 300, 1,200, and 3,400 sows, they used regional input-output analysis to estimate the multiplier effects of each size of operation. In the first paper (Otto, Lawrence, and Swenson, 1996), they report the impacts under two different assumptions about corn. In the first case, they assume that the additional pork production will stimulate additional corn production, resulting in higher regional

[i] This literature review draws heavily on the work by George Morse and Steffanie Guess-Murphy as reported in Phillips et al.

employment and incomes. In the second case, they assume that there already is a surplus of grain and that this is exported out of the region. In this case, the additional pork production would result in reduced exports but no increase in corn production. Consequently, the spin-off effects would be less. The data from Purdue shows a negative return to capital for the 150-sow unit with proportionally higher returns to the larger units.

The authors compared the impacts of the 150-sow unit with the 300, 1,200 and 3,400 sow units. Naturally, the larger units show more positive impacts on the total number of jobs. The scenario that assumed corn production would increase as a result of the pork production yielded slightly higher total employment but lower earnings per worker.

Thompson and Haskins correctly criticize the 1998 article (Otto, Orazem, and Huffman) for failing to compare the net impacts on the community if all the production had been in the smaller farms rather than the larger ones. Using the data from the Otto et al. reports, Thompson and Haskins show that if twenty-three 150 sow farms are compared to one 3,400 sow farm, the twenty-three farms employ 32 persons while the 3,400-sow farm only employs 21. Likewise, the total multiplier effect yields 61 persons for the 150-sow operations compared to 40 for the 3,400-sow operation.

However, Thompson and Haskins incorrectly suggest that it does not matter whether or not a particular size of operation survives or not. Their argument appears logical if all sizes of hog operation are equally likely to survive over the long haul. If one size is more likely to fail than the other, then we need to estimate the probability of survival and multiply that times the estimated impacts in order to get a reasonable estimate of the long-term impacts on the region. Neither Thompson/Haskins nor Otto et al. makes this type of estimate.

Thompson and Haskins then question the veracity of the cost data used by Otto, et al. While possibly these data are incorrect, Thompson and Haskins provide no evidence to this effect.

In his analysis of independent hog farming and contract hog production, Ikerd (1998) states that a sustainable agriculture paradigm is the only way for rural America to survive. The sustainable agriculture paradigm "relies more on people, including the quality and quantity of labor and management, and relies less on land and capital" (p. 158). Ikerd criticizes a study done in Missouri about the future of pork production in the state (DiPietre, 1992). Ikerd argues that the Missouri report indicates that the drop in total pork production in Missouri is the main problem in the state and that the solution is to bring in large corporate hog producers. However, Ikerd feels that the report ignores the issue of whether increased hog production is a sustainable development policy for Missouri. He argues that the biggest problem in the state is the declining number of quality job opportunities, and bringing in large hog operations will not solve this problem because large hog operations reduce costs by using technologies that reduce the number of people needed. Thus, total employment in pork production is reduced.

Ikerd goes on to compare the Missouri study's (DiPietre, 1992) findings with the reports from actual Missouri hog operations. He says that the major difference between contract farming and independent hog farming stems from the amount of labor required in each. As shown in DiPietre's study, contract hog operations only employ 4.25 people whereas independent hog farming (as reported by the Missouri Farm Business Summary) employs12.60 people (p. 163). Also, including indirect effects, contract hog farming needs 9.44 people to produce 12,000 hogs (p. 163). Independent hog farming needs 27.79 to produce the same number of hogs (p. 163). Thus, according to Ikerd, a "$5 million investment in contract production would generate 40 to 50 new jobs but would displace approximately three times that number of independent hog farmers" (p. 163).

Ikerd also criticizes the results obtained from models such as IMPLAN. He argues that family farm impacts on local incomes and employment are typically underestimated. Ikerd reports that half of the farmers were sustainable farmers and half were considered conventional farmers and that conventional farms were at least double the size of the sustainable farms. It was found that the sustainable farms had a higher average farm income than the conventional farms. Also, 66 fewer people would be employed if all of the farms were the conventional size (p. 165). Family income would also be lower if all the farms were conventional. Sustainable farms would more than double family income as compared to conventional farms (p. 165). Ikerd argues that an input/output analysis would show different results. While Ikerd suggests that the analysis would reveal that the two different size farms would have similar impacts, this is unlikely if different production functions are used and if the purchasing patterns are different. The IMPLAN results will yield identical results only if the production functions and regional purchase coefficients are identical.

Four studies estimated the economic impacts of pork production in their respective state using input-output analysis (DiPietre and Watson, 1994; McKissick, Turner, Kriesel, Luke, and Cato, 1998; Thornsbury, Kambhampaty, and Kenyon, 1996; Warner and Plaxico, n.d.). The four states that were covered in these analyses were Missouri, Georgia, Virginia, and Oklahoma, respectively. The Missouri and Georgia studies used IMPLAN for their analysis. The Missouri study estimated the economic impact of Premium Standard Farms on the economy of Missouri and on the five-county region where most of the effects originate. This study estimated the employment, personal income, and output impacts of Premium Standard Farms. The Georgia study estimated the total economic output, wages, and employment impacts of four different size plants on Bacon County, Georgia. It concluded that using public investment to support large-scale hog operations was justifiable. The authors of this study explain the assumptions that must be made when using IMPLAN. They did not try to relax any of the assumptions in their study, so their estimates may not be accurate. The Virginia study estimated the economic and fiscal impacts of an expanding swine complex in Southside Virginia. This study used IMPLAN to derive multipliers. The authors then used these multipliers in the Virginia Impact Projection (VIP) model to estimate the impacts. The main impacts estimated were employment, income, retail sales, and tax base impacts. The authors of this study did not detail the VIP model or the procedure that they used, so no conclusions can be made about the validity of their results. The Missouri and Virginia

studies also estimated the impacts that would occur during the construction phase of the new plant. The authors of the Oklahoma study did not specify what kind of model they used in their analysis. They just stated that it was an input-output model. Thus, no conclusions can be made about their results.

A 1998 study was conducted in Canada that used economic impact analysis to estimate income and employment impacts and social impact analysis to assess government and community concerns (Serecon Management Consulting Inc.). This study used a form of economic base model. Consequently, the results can provide no detail on the sectors that are impacted.

The studies that come the closest to providing the type of information needed for evaluating the feedlot issue at the local level or evaluating proposals concerning the most desirable structure of pork farming (mostly large or mostly small) are the ones by Otto, Orazem, and Huffman, 1998; and Otto, Johnson, and Swenson, 1996. However, even if their results are reasonable they would not translate easily to Minnesota's economy and fiscal structure. Since most decisions on zoning are made at the local level, estimates need to be run for each proposed project rather than at the state level. However, the Otto et al. studies did not adjust for local spending patterns by size of operation. Further, their production functions were adapted from another state. And finally, they did not adjust the estimates for changes in survival.

3.2 Purchasing Patterns of Pork Producers

The economic impacts of any firm or farm depends on where it purchases the inputs it needs. Even if all of the inputs are purchased locally, there might be leakages out of the county if the inputs are not produced within the area. Some earlier research has looked at the purchasing patterns of livestock. None of this prior research has looked intensively at pork producers by type and size. This earlier research is reviewed now.

The impacts for any specific feedlot will vary with the location of the feedlot, the nature of that county's local economy, the nature of the feedlot, and the spending patterns of the producer. In addition, the net impacts will vary with the type of other development displaced, if any.

All non-survey input-output models must estimate the amount of inputs to a sector that are imported from outside the region being studied. Generally, this is considered one of the weakest aspects of the non-survey input-output models (Stevens, Treyz, and Lahr, 1989; Scott, Haskings, and Brucker, 1985; Swanson, 1998). Most of the regional input-output models use an econometric estimate of the RPC or estimate it via the supply-demand pool method (Olson and Lindall, 1996). The later method assumes that all local purchases come from local supplies prior to going to imports.

Where do farmers buy their inputs? Do large livestock farmers buy less locally than small ones? If so, the multiplier or spin-off effects of large farmers are less than for smaller ones. Sociologist Walter Goldschmidt predicted the demise of rural

communities based on the view that large farms would buy less locally (Goldschmidt, 1978).

Chism and Levins (1994) found that farmers generally believe that large farmers are less likely to buy locally than small ones. They surveyed 30 farmers on their opinions about local vs. non-local spending. They found that these farmers felt: 1) larger farmers would benefit more from small differences in prices and would have greater incentives to purchase in non-local markets, 2) large farmers had greater capacity to shop around the region for discounts, and 3) large farms often needed specialized inputs not available locally (p. 1). In addition, Chism and Levins examined the expenditure records of crop and livestock farmers to determine their actual spending patterns.

The Chism/Levins article is cited widely (Ikerd, p. 157; DeLind, 29; Thu and Durrenberger, p. 7; Lasley, p. 127). Yet, those citing the Chism/Levins article did so incorrectly.

In the Master's thesis on which the Chism/Levins article is based, Chism (1993) points out that the more livestock intensive farmers spent more locally on a per acre basis than the more crop intensive farmers. From this, Chism suggests that:

> "By creating a hostile climate for livestock farmers, some small, rural communities may be putting greater negative economic pressure on many of their agricultural merchants by unwittingly lowering the total volume available from the surrounding countryside." (p. 44)

The Chism/Levins study has two methodological problems, however. The livestock conclusions are based on a very small sample (12 farms). "Local" was defined as a 20-mile radius of each farm. While this seems reasonable, it leaves unclear where the non-local spending goes. Does it go to other rural areas? Given today's transportation networks and the distance that many rural people commute to work, should alternative estimates be considered?

In a staff paper from Iowa State, Lawrence, Otto, Meyer, and Folkerts report on a 1993 survey of pork producers spending patterns. These authors report that a larger percentage of large producers travel longer distances to purchase inputs compared to smaller producers. However, they do not report the per-acre spending which is needed to determine the local economic impact. Otto in summarizing this work writes:

"Producers of all size operations appear to be willing to shop in more distant communities for their inputs and services. For producers who indicated they did not buy inputs in the nearest community, quality and service were most frequently given as reasons when professional services such as accounting, banking, and veterinary medicine were involved. Pricing became the predominant factor in producer decisions to purchase general supplies and hog equipment. Producers' concern with price and non-price attributes of inputs and services suggest that local agribusinesses in rural communities are likely to face increased competitive pressures from larger and more distant businesses.

Rural agribusiness firms that are unable to provide specialized expertise may have difficulty competing in this environment." (pp. 17 and 18).

3.3 Impact of Pork Production on Local Governments

This section reviews the documentation regarding the effects of animal agriculture on the tax base and taxes in general of the respective region. Currently there are other no completed studies on the tax base or taxes stemming from pork production in Minnesota.

Only one study was found that dealt with the effects that pork production could have on taxes and the tax base. In a 1998 Iowa study, Otto, Orazem, and Huffman estimate the changes in expenditures and revenues for local units of government as a result of four different sizes of farrow-to-finish operations. Since the authors do not report any details on the nature of their model, it is difficult to evaluate the veracity of the estimates.

3.4 Prior Research on Changes in Corn Prices

Hayes, Otto and Lawrence examined the prices of corn and soybeans in topographical maps in Iowa and how they change as areas reach complete utilization of their own production. This question was revisited in the present study for two reasons: a) no research of this type has been done for Minnesota, and b) Hayes et al. did not directly relate the changes in local price patterns to changes in utilization.

3.5 Conclusions Drawn from the Literature Review

As the above discussion indicates, there is still an information gap surrounding the economic and fiscal impacts of pork production. First, many of the studies used input-output models to study the economic impacts of pork production. However, integrated econometric/input-output models offer the best promise for estimating the regional economic and fiscal impacts. As was shown, this type of model has only been applied to the pork industry in Iowa (Otto, et al., 1996; Otto, et al., 1998). Second, none of the studies have correctly examined the effects of survival rates. Third, only one study was found that dealt exclusively with the purchasing patterns of pork producers (Lawrence, Otto, Meyer, and Folkerts). However, the authors did not report the necessary information needed to determine the local economic impact. Fourth, only one study was found that dealt with the effects that pork production could have on taxes and the tax base (Otto, Orazen, and Huffman, 1998). However, the authors failed to report any details of their model. Finally, and probably most importantly, little research was found that dealt exclusively with issues of pork production in Minnesota.

IV. Overview of Regional Economic Impacts of the Minnesota Pork industry

The first objective of this project was to estimate the regional economic impacts of the pork industry on employment and income both within the pork industry and in supply industries that depend on the pork industry.

The economic impacts of any industry on its region depend on what inputs it purchases and where it purchases them. Businesses that buy a large amount of inputs and buy them locally have much higher multiplier effects than those that buy few inputs or buy them from outside the local economy. Are large pork producers more likely to purchase outside the local economy? If so, will that reduce the local economic impacts significantly?

In addition, the size of the multiplier effects depends on the structure of the rest of the local economy. Local economies that are highly integrated yield greater multiplier effects than those that are not. Consequently, two identical pork producers located in two different counties are likely to have different impacts on the local economies. How much difference does the structure make in regional economic impacts?

The production functions of different types of pork operation (farrow-to-finish or finishing) are different. This translates into different purchases of inputs and different potential multiplier effects. How much difference does this make in the regional economic impacts?

The regional economic impacts can be examined in a number of ways. We focus on changes in employment and changes in value-added income. Value-added income includes all wages and fringe benefits paid to employees, income received by self-employed persons, rents, and profits.[ii]

In summary, this research incorporates the following new approaches to estimating the regional economic impacts of pork production:

1) two types of pork operations are considered (farrow-finish, and finishing);
2) two sizes of operation for each type of operations are considered;
3) expenditure functions are derived from Minnesota farm management data;
4) labor requirements are estimated from Minnesota farm management data;
5) employee salary estimates are derived from preliminary results from the National Pork Producers Council's year 2000 national survey of personnel management practices on swine operations; and
6) purchasing patterns for different types of operations and locations were obtained by surveys of pork producers; and

[ii] It also includes a small amount of indirect taxes (excise and sales). These are relatively minor compared to the other components.

7) survival rates are considered to develop long-term estimates of impacts.

Initially we present results on the economic impacts of the Minnesota pork industry on the entire state in order to give an overall picture of the importance of this industry. Next we look at how the economic impacts vary depending on the operation type, size, and local economy.

V. Pork Industry's Economic Impacts on State of Minnesota

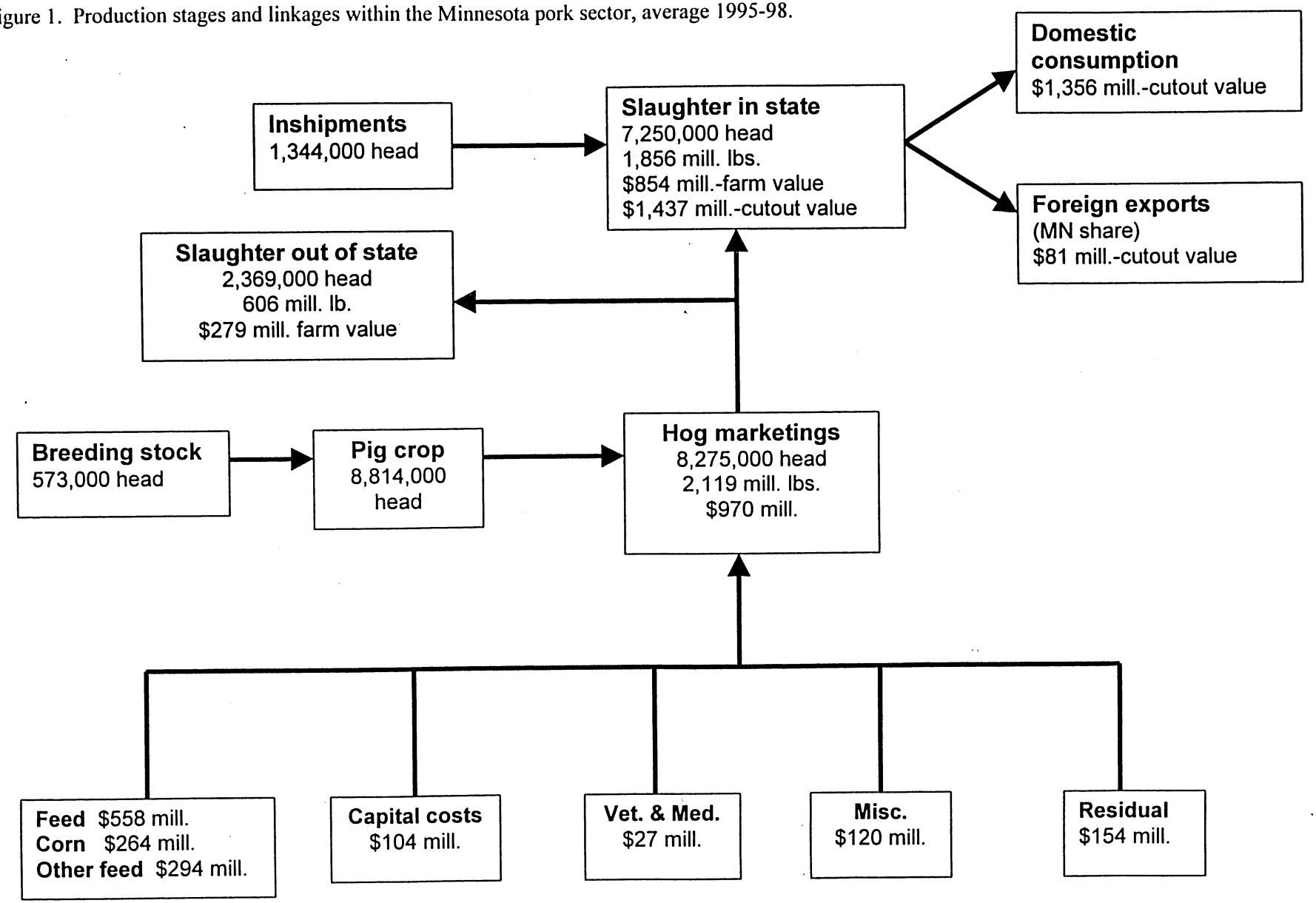
Figure 1 shows a schematic summary of production stages and linkages within the Minnesota pork industry. Marketings and slaughter are averages for the four-year period 1995-98. Resources used in pork production were estimated on a per hundredweight basis based on farrow-to-finish swine enterprise record summaries from farms in the Southwestern Minnesota Farm Business Management Association in 1995 and 1996, and in the Minnesota State College University System's Farm Business Management (FBM) program in 1997 and 1998.

If the mix of resources used by the rest of the industry is similar to that of summary farms, then the pork industry purchased inputs valued at $809 million from other industries (including homegrown corn as a separate "industry" here because it could have been marketed in the absence of the hogs). This is 83 percent of the $970 million in gross receipts from hogs marketed. Feed costs are the largest single cost item at $558 million. Capital costs including depreciation, interest payments and leases were $104 million, while veterinary and medicine expenses totaled $27 million with $120 for other expenses. In percentage terms, feed represents 57 percent of gross receipts with capital costs, veterinary/medicine and other expenses making up 11, 3, and 12 percent, respectively.

The $154 million residual value (16 percent) which remains after purchasing inputs from other industries covers payments for the "primary inputs" of hired labor and operator-supplied labor and management skills, business taxes (property and sales taxes but not income taxes, which are counted elsewhere, against households' income), and a return to operators' equity capital and risk-taking. The $558 million in feed expenses includes an estimated $264 million in corn (104 million bushels at an average $2.54 price per bushel) and $294 million in other grains as well as protein supplements and complete feeds. The supplements and complete feeds would represent about 24 million bushels of soybeans[iii].

[iii] The corn content of the complete feeds and supplements was factored in by assuming that the complete feeds averaged 80% corn and 20% supplement, and the supplement was 86% soybean meal and 14% corn.

Figure 1. Production stages and linkages within the Minnesota pork sector, average 1995-98.



Most of Minnesota's hogs are slaughtered in the state, with slaughter averaging 1,513 million pounds liveweight or 70 percent of marketings over this three-year period. USDA reports that the average farm-cutout price spread averaged 41 percent of the cutout value over this period. Based on this estimate of margins, the cutout value was $1,176 million. The total $1,176 million is then distributed and sold to consumers. The market for pork is almost entirely domestic, but exports averaged 5.6 percent of production over this period. Minnesota's share of exports would then come to $66 million with the remaining $1,109 million in cutout value being consumed domestically.

Table 1 shows the overall economic impacts of the pork industry on the entire state of Minnesota. These impacts include both farm pork production and pork processing. It includes the employment on farms and processing plants and the indirect employment in supply industries to these two aspects of the industry. It does not include the consumer spending by employees or owners of any of the businesses. The total of the direct, indirect, and induced (or consumer) spending is shown in Table 2.

Pork production and processing accounted for about ¾ of one percent of Minnesota's total economic output in 1996. Naturally, it would be a much larger portion of rural area economies. When the economic activity that depends on pork production and processing is considered, about 1.3 percent of the Minnesota economy depends on this industry.[iv]

[iv] In both cases, we used the 1996 output of $263 billion. The meat packing plants and sausage and other meat products plants are not reported separately for pork production. Consequently, we assumed 1/3 of this was for pork.

Table 1. Economic Impacts of Pork Production and Processing, Minnesota, 1996 (including only direct and indirect effects)

Industry	Industry Output ($ million)	Wages and proprietors' income ($ million)	Value Added ($ million)	Employment (jobs)
Hog Production				
Direct	1,020	98	102	4,133*
Indirect	61	5	5	195
Total	1,082	102	107	4,328
Rest of Agriculture	229	54	105	4,050
Construction	116	46	50	1,055
Manufacturing				
Pork Processing	1,210	129	131	4,431
Other	397	37	57	862
Total	1,607	166	188	5,293
Transportation, Communications, & Utilities	123	36	65	921
Trade	180	74	125	1,765
FIRE	139	33	95	1,078
Services	111	57	67	2,332
Government	7	4	4	80
Other	0	0	0	7
Total Economic Effect	3,595	572	805	20,907

* The state-level model run with meatpacking impacts included, only showed hog production for export as direct impacts and the rest as indirect or induced. For example, direct employment was 1,168 and indirect was 3,159. The state-level run without meatpacking showed direct pork production employment of 3,196 and indirect employment of 195. In Table 1, to improve clarity the indirect employment is shown as direct except for the 195 which may represent breeding stock production.

Table 2. Economic Impacts of Pork Production and Processing, Minnesota, 1996 (including total effects)

Industry	Industry Output ($ million)	Wages and proprietors' income ($ million)	Value Added ($ million)	Employment (jobs)
Hog Production				
Direct	1,020	98	102	4,133*
Indirect	61	5	5	195
Induced	3	0	0	10
Total	1,084	103	107	4,338
Rest of Agriculture	235	55	108	4,117
Construction	126	50	55	1,174
Manufacturing				
Pork Processing	1,214	130	132	4,446
Other	445	47	73	1,114
Total	1,659	177	205	5,560
Transportation, Communications, & Utilities	161	46	87	1,158
Trade	295	126	206	4,468
FIRE	253	51	176	1,660
Services	262	136	156	5,330
Government	15	7	8	151
Other	1	1	1	89
Total Economic Effect	4,092	752	1,108	28,045

* The state-level model run with meatpacking impacts included, only showed hog production for export as direct impacts and the rest as indirect or induced. For example, direct employment was 1,168 and indirect was 3,159. The state-level run without meatpacking showed direct pork production employment of 3,196 and indirect employment of 195. In Table 1, to improve clarity the indirect employment is shown as direct except for the 195 that may represent breeding stock production.

VI. Regional Economic Impacts of the Minnesota Pork industry

The economic impact of the pork industry in an area depends on the size and type of operations, the structure of the local economy, the purchasing patterns of pork producers and the competitiveness of the local producers. We will look at each of these factors, starting with competitiveness.

6.1 Competitiveness and Farm Survival

Evaluating how competitive the Minnesota pork industry would be under different structures is a challenge. The most rapid growth in the pork industry today appears to be coming in the very large or "mega" operations of at least 50,000 head marketed per year or roughly 2,500 sows or more. The only research covering the megas is the set of surveys of mid- to large-sized pork producers conducted in recent years by researchers at Iowa State University and the University of Missouri. The most recent report is Lawrence et al. (undated). It was based on responses from 2,030 producers from the nationwide Vance Publishing mailing list of pork producers compiled by *Pork* magazine, of which 391 marketed 10,000 hogs or more annually. Producers were not asked for detailed cost records. Rather, they were asked to identify their minimum "stay in" price, defined as the hog price they would need to stay in business for the next 3-5 years if the central Iowa corn price was $2.50 per bushel. Their responses likely reflect their variable cost of production and their perceived opportunity cost for resources used in pork production. There are likely to be many factors that influence whether a producer "stays in," however, so this is a rough measure at best.

"Stay in" prices vary widely for all size classes, but especially for the smaller ones. The responses indicate that at very low prices of $36 per hundredweight, a larger share of the smallest producers would stay in compared to larger producers (Table 3). For example, 16.6% of the producers in the size class of 1,000 - 2,000 head would stay in business at a $36 hog price, while only 6% of those in the 50,000 - 500,000 size class say they would stay in. The best estimate of an average cost of production might be the price where operations producing at least half of the size class' hogs would stay in. By that measure, the megas are likely to have a production cost advantage of perhaps $1-$3 per hundredweight.

Table 3. Willingness to Stay in Production Until 2002 by Size Group at Each Hog Price

Size class	Marketings by Size Group and Hog Price				
1,000 hd.	$36	$39	$42	$45	$48
	(percent of all hogs produced by operations in the size class)				
1-2	16.6%	42.0%	66.0%	85.4%	93.9%
2-3	13.0%	37.3%	68.1%	90.9%	95.7%
3-5	12.7%	38.5%	67.4%	82.8%	97.1%
5-10	10.2%	37.6%	71.9%	91.2%	97.3%
10-50	9.6%	33.2%	62.2%	87.2%	96.7%
50-500	6.0%	21.0%	61.0%	96.0%	100.0%
500+	9.0%	51.0%	89.0%	98.0%	100.0%

Source: John Lawrence, Glenn Grimes, and Marv Hayenga. Production and Marketing Characteristics of U.S. Pork Producers, 1997-1998, Staff paper 311, Iowa State University, Ames, Iowa.

Another widely cited source of information on economies of size in pork production is Foster et al. (1995). This contains budgets for four sizes of farrow-to-finish swine operations from 150 to 1,200 sows, and estimates the impacts of several specific technologies on profitability. They found greater economies of size than the Grimes et al. Survey would indicate. Total production cost for a 1,200 sow high technology operation was $34.25 compared to $40.54-47.88 for a 150 sow operation depending on the level of technology used and performance achieved on the smaller operation. The cost advantage for the larger size was then in the range of $6-14/hundredweight. A companion paper compared a 3,400-sow operation with 250 and 650 sow sizes (Hurt et al., 1995). They found that the 3,400 sow size resulted in $4.28/hundredweight lower production costs than with 250 sows, and $1.86 less than with 650 sows, under Midwestern U.S. conditions. They also found that the Midwestern 3,400-sow size had a cost advantage over the same size operation in North Carolina, because of lower feed costs. The data sources for the Purdue budgets are not documented in detail. It is not clear how directly their costs were based on record summaries or surveys, and how much was based on expert opinion and anecdotal information. There is always the chance that any budget study may leave out certain costs or management issues which may affect the results that average farms may experience. As a result, surveys such as the Lawrence et al. survey discussed earlier, and record summaries, are more reliable indicators of overall industry conditions when available.

Table 3 shows that the smallest operations thought they were better able to deal with low prices than were the larger sized operations. It has been suggested that the smaller operations may have lower variable costs and greater fixity in their farm assets and cost structure. The lower variable costs might be related to more of their feed being raised rather than purchased, and depreciated and paid off facilities and equipment. The lack of flexibility in their cost structure may make them more likely to "tough it out" under adverse economic conditions. The information in Table 3 is not adequate to test such hypotheses.

Despite this evidence, historical data show that the number of small operations is declining while the number of larger ones is increasing. Table 4 shows recent trends in inventories and numbers of operations by operation size (inventory of pigs on hand, based primarily on mid-year surveys) from recent December USDA Hogs and Pigs reports. The 2,000-pig inventory size breakpoint would correspond roughly with our 5,000-head sales breakpoint, assuming around 2.7 turns per year for finishing facilities. The third panel of Table 4 shows that 1999 inventories on operations under 2,000 inventory were two-thirds of what they were in 1995. Inventory is arguably a better measure of economic impact to use for our purposes than is the number of operations, but by the latter measure small operations have declined by a third in just the past two years (1997 to 1999).

Table 4. Trends in market share of swine operations by size, Minnesota

	Operation size, inventory of pigs on hand*			
	All operations	<2,000	2,000+	5,000+
	Percent of inventory by farm size			
1994	100%	71%	29%	na
1995	100%	63%	37%	na
1996	100%	58%	42%	24%
1997	100%	55%	45%	25%
1998	100%	44%	56%	35%
1999	100%	39%	61%	39%
	Pig crop by operation size, December-November annual*			
	(000)	(000)	(000)	(000)
1994	8,798	6,247	2,551	na
1995	8,632	5,438	3,194	na
1996	8,138	4,720	3,418	1,953
1997	8,873	4,880	3,993	2,218
1998	9,612	4,229	5,383	3,364
1999	9,289	3,623	5,666	3,623
		1999 % of year:		
1994	106%	58%	222%	na
1995	108%	67%	177%	na
1996	114%	77%	166%	185%
1997	105%	74%	142%	163%
1998	97%	86%	105%	108%
1999	100%	100%	100%	100%
	Number of operations with hogs			
1994	14,000	13,600	400	na
1995	12,000	11,600	400	na
1996	11,000	10,500	500	350
1997	10,800	10,250	550	400
1998	8,500	7,850	650	470
1999	7,500	6,750	750	530
		1999 % of year:		
1994	54%	50%	188%	na
1995	63%	58%	188%	na
1996	68%	64%	150%	151%
1997	69%	66%	136%	133%
1998	88%	86%	115%	113%
1999	100%	100%	100%	100%

*An operation is any place having one or more hogs and pigs on hand any time during the year. Percentages by size reflect average distributions based primarily on mid-year surveys.

Source: USDA-NASS, Hogs and Pigs

Because of the difficulty of estimating the relationship between farm size and profitability, let along the relationship between profitability and overall industry output, we used the simple historical trend in this study. First, output was held constant at $40 million, and the economic impacts of four structural alternatives were compared. Then, we adjusted the impacts by the percentage change in the number of farms in that size category over the past six years. In 1994, there were 11,500 operations with hogs in Minnesota. By December 1999, that number had dropped by about one-third to 7,500, according to the USDA National Agricultural Statistics Service. Since the vast majority of these farms would fall into the "small" category, we adjusted the impact of the small farm categories by this amount.. The number of farms in the "large" category was not adjusted. The results of fourteen different scenarios are shown in 54. For each county except Murray County, there are four different scenarios. These are:

1) farrow-finish small (less than 5,000 head finished per year)

2) farrow-finish large (5,000 head or more finished)

3) finish small (less than 5,000 head finished), with the pigs supplied by a large (1,400 sow) farrowing unit

4) finish large (5,000 head or more finished), with pigs from a large (1,400 sow) farrowing unit

Murray County did not have the larger units and it was not possible to collect the data for the purchasing patterns for them. Details on the sample and survey are provided later.

For each type of operation, the total output in the county generated by $40 million in pork production is shown. For example, in Blue Earth County, a total of $62 million in output is generated as a result of the $40 million in pork production. The $22 million is gross revenue to firms which are selling inputs to the pork industry or selling consumer items to the employees of either the pork industry or those of the other industries that support the pork industry.

Of the $62 million generated by small farrow-finish operations in Blue Earth County, $10 million goes to employers or farmers and other business owners as wages or personal incomes. Also included in income is another $5 million in property taxes and other indirect taxes.

In total, the Blue Earth County economy would have 429 jobs that depend directly or indirectly on the $40 million in pork production.

6.2. Regional Impacts: Comparison of Size and Type of Operation

As shown in the top half of Table 5, the impacts of the four different scenarios vary considerably. For example, in Blue Earth County the small finish/large farrowing unit results in nearly 50 percent more employment impact than the large finish/large farrowing unit. While the percentage differences vary, similar results are found in every

county. Likewise, there are differences between the small farrow-finish units and the small finish and large farrowing units. For example, in Blue Earth County the former had only 95 percent of the impact as the latter. These differences stem from the differences in production functions for the different sizes of units. The production functions will be discussed later.

Note, however, that these results assume that all the units survive. If the historical rate of closure holds over the next five years, the smaller units generally have lower impacts than the larger ones. However, after adjusting for survival rates, the differences between sizes and types of operations are very small. With only one exception (Blue Earth large farrow-to-finish) the differences in regional impacts were 10 percent or less. This suggests that the size of the operation might not matter all that much in terms of the total employment impacts in the region. The small operations have greater impacts but are less likely to survive so the expected value of the long-run impacts is less.

6.3 Regional Impacts: Comparison of Counties

Next we examined the impacts of the same types of unit in different counties. For example, consider the small farrow-finish operation. In this case, the employment in Murray County is only 82 percent that of Blue Earth County. Likewise the small finish/large farrowing units in Murray County yield only 78 percent of the impact that the same size and type of unit yields in Blue Earth County. While Martin County and Blue Earth Counties had very similar impacts for the small farrow-finish and the large finish/large farrowing units, the Martin County impacts were about 15% lower for the other two. These differences stem from the differences in the local economic structure and in the purchasing patterns of producers. We turn to those differences later.

6.4 Production Functions by Size and Type of Operation

The IMPLAN input-output model used for this analysis estimates the overall economic impact of changes in an industry using as a starting point a set of direct purchase coefficients that describe the amounts of purchases that industry (the pork industry, in this case) makes from other industries for every $1 in output the industry produces and sells. This set of purchase coefficients is termed a "production function."

The default IMPLAN production function for the pork industry was tailored to the specific types and sizes of operations of interest to our study. The modifications were derived from 1998 average costs and returns for 359 swine operations in the Minnesota State College University System's farm business management program. The modified coefficients are shown in Table 6. The derivation was performed by first translating each expense category in the FINPACK enterprise summary format to the closest IMPLAN industry classification. The IMPLAN format is on a per dollar of output or sales basis while FINPACK is on a per hundredweight produced basis, so feeder pig and breeding stock purchases, which are netted out in the gross return section of the FINPACK format, were reclassified as expenses for our purposes.

Other challenges were: 1) deciding how to make the IMPLAN analysis reflect a long run average hog price situation rather than a particular point in the price cycle, and 2)

differences in per unit costs and returns across the different operation types and sizes. Feed costs were very similar across the sizes, while total expenses/cwt increased with size. The difference in total costs runs counter to the Lawrence and Purdue results discussed above. The cost difference may be due to facility investments and contract finishing arrangements that some of the larger operations may have undertaken. A comparison of the 5,000 plus and the 1,001-2,500 categories showed that the larger size had higher interest, depreciation, and lease expenses, which would be expected with new facilities. Over the long run, the smaller operations may also need to upgrade or replace facilities which is likely to narrow this difference. Custom hire expenses were also up, which could be related to arrangements with neighbors to finish extra pigs on an informal contract basis, and veterinary expenses.

The cost advantage of the smaller operations was overshadowed by the difference in prices received. The larger operations received a higher average price than did the smaller operations ($41.21/cwt for those selling over 5,000 head compared to $32.69 for those selling less than 1,000).

There are at least four possible explanations for why the smaller operations received lower prices:

1) the smaller operations may have operated on more of a seasonal basis, and might have sold a larger share of their production at times of the year when prices were low,
2) there might have been carcass quality differences,
3) some of the larger operations might have received price differentials related to quantity, such as marketing truck-load lots directly to packing plants rather than going through local buying stations, or
4) a higher proportion of the larger operations might have been marketing under long-term marketing contracts that paid more than the spot price.

Anecdotal information suggests that a fairly large proportion of Minnesota producers have entered into long-term marketing contracts with packers. One common type of marketing contract is what is termed a "cash flow assistance" contract. In these contracts, the difference between the contract price paid to the producer and the (currently lower) spot market price is a loan to the producer which is to be paid back to the packer later when spot market prices recover. Accountants and lenders have been struggling with whether and how to include the amounts of those loans in producers' financial statements because their status depends on what hog prices do in the future. Those loans were generally not included as liabilities in the farm business summaries in 1998, so to that extent the 1998 returns may be overstated especially for the larger swine enterprises, which tended to utilize marketing contracts more than the smaller ones.

For the purposes of the present study, we recalculated the returns using a constant $44 per hundredweight market hog price for all of the operation types and sizes to reflect a long run situation rather than specifics of 1998's depressed market.

The IMPLAN format requires labor quantity and compensation numbers, divided between hired labor and proprietors' labor and management. Quantity of hired labor was calculated from the hired labor costs in the MnSCU data by applying average salary

levels from a survey of swine operations conducted in early 2000 (Hurley, 2000). The MnSCU data includes total labor quantity per unit and an opportunity charge on operator labor and management, both of which are calculated by starting with whole-farm totals and allocating across all enterprises on each farm. It is unclear how producers will be able to adjust input expenses over the long run as the hog market changes, and how much of the changes will be reflected in the residual returns to their labor and management. The coefficients on operator labor and management shown in Table 6 are based on the labor quantities from the MnSCU data along with the salary data from Table 12, with the residual assumed to fall into the "other industries" category.

Table 5. Economic Impacts of $40 Million in Pork Production by Size and Type of Operation, with and without survival adjustment in selected Minnesota Counties, 1999

Operation type and size	Industry Output ($ million)	Wages and proprietors' income ($ million)	Total Income ($ million)	Employment (jobs)
Assumes all sizes and types of firms continue to operate over the next five years				
Blue Earth County				
Farrow-finish small	62	10	15	429
Farrow-finish large	59	9	14	361
Finish small & large farrowing unit	87	10	16	450
Finish large & large farrowing unit	71	7	11	299
Martin County				
Farrow-finish small	57	9	14	414
Farrow-finish large	50	7	11	286
Finish small & large farrowing unit	75	8	12	380
Finish large & large farrowing unit	69	6	9	284
Murray County				
Farrow-finish small	53	7	11	350
Finish small & large farrowing unit	70	7	11	352
Pipestone County				
Farrow-finish small	53	8	12	382
Farrow-finish large	52	7	12	310
Finish small & large farrowing unit	76	8	13	423
Finish large & large farrowing unit	71	6	9	296
Assumes large operations continue to operate over the next five years But that only 66% of the small ones continue in operation				
Blue Earth County				
2/3 of farrow-finish small	42	7	10	287
Farrow-finish large	59	9	14	361
2/3 of finish small & farrowing unit	58	7	11	302
Finish large & large farrowing unit	71	7	11	299
Martin County				
2/3 of farrow-finish small	38	6	9	277
Farrow-finish large	50	7	11	286
2/3 of finish small & farrowing unit	50	5	8	255
Finish large & large farrowing unit	69	6	9	284
Murray County				
2/3 of farrow-finish small	36	5	7	235
2/3 of finish small & farrowing unit	47	5	7	236
Pipestone County				
2/3 of farrow-finish small	36	5	8	256
Farrow-finish large	52	7	12	310
2/3 of finish small & farrowing unit	51	5	9	283
Finish large & large farrowing unit	71	6	9	296

Table 6. Comparison of swine enterprise production functions by operation type and size, Minnesota, 1998

	Swine Operation Type and Size						
	Farrow-finish		Finish			Farrow to Nursery	Overall
Supplying industry	5,000 or Less Finished	Over 5,000 Finished	1,000 - 2,500 Finished	2,501-5,000 Finished	Over 5,000 Finished	1,400 Sows	Industry
	-----	-----	(cents/$1 of output)		-----	-----	-----
7 Hogs, pigs	0.0730	0.0688	0.3923	0.4472	0.4223	0.1394	0.0688
12 Feed grains	0.1665	0.1525	0.1476	0.1449	0.0762	0.0640	0.1525
26 Agricultural services	0.0255	0.0251	0.0070	0.0049	0.0093	0.0620	0.0251
52 New farm structure	0.0779	0.1181	0.0411	0.0544	0.0938	0.1220	0.1181
78 Prepared feeds	0.0196	0.0207	0.0478	0.0284	0.2204	0.2030	0.0207
87 Soybean mills	0.3307	0.3487	0.1535	0.1700	0.0532	0.0542	0.3487
204 Health supplies	0.0136	0.0135	0.0034	0.0090	0.0036	0.0000	0.0135
242 Excavation and concrete	0.0010	0.0011	0.0022	0.0022	0.0008	0.0000	0.0011
282 Framing structure	0.0212	0.0133	0.0067	0.0053	0.0067	0.0000	0.0133
309 Feding manure and handling equiment	0.0036	0.0012	0.0028	0.0031	0.0000	0.0456	0.0012
347 Heating and ventilation equipment	0.0024	0.0016	0.0049	0.0011	0.0008	0.0000	0.0016
435 Transport	0.0060	0.0038	0.0103	0.0060	0.0062	0.0000	0.0038
443 Electric services	0.0034	0.0058	0.0005	0.0004	0.0007	0.0357	0.0058
444 Gas production & distribution	0.0084	0.0047	0.0048	0.0049	0.0012	0.0000	0.0047
456 Banking	0.0417	0.0504	0.0392	0.0385	0.0253	0.1062	0.0504
460 Insurance agents	0.0076	0.0063	0.0065	0.0049	0.0030	0.0016	0.0063
503 Financial records	0.0156	0.0090	0.0093	0.0084	0.0046	0.0000	0.0090
507 Accounting	0.0005	0.0005	0.0004	0.0002	0.0006	0.0000	0.0005
Other industries	0.0731	0.0448	0.0556	0.0045	0.0202	0.0000	0.0445
Total interindustry purchases	0.8911	0.8897	0.9360	0.9384	0.9489	0.8336	0.8896
Hired labor	0.0460	0.0779	0.0161	0.0225	0.0328	0.1435	0.0779
Operator labor & management	0.0598	0.0295	0.0458	0.0370	0.0170	0.0000	0.0295
Property taxes	0.0032	0.0030	0.0021	0.0020	0.0013	0.0229	0.0030
Total value added	0.1089	0.1103	0.0640	0.0616	0.0511	0.1664	0.1104
Total purchases	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Source: Derived from unpublished 1998 business summaries of 359 farms with hogs in the Minnesota State College University System's farm business management program.

6.5 Regional Purchase Coefficients by Size and Type of Operation

Table 7 shows the regional purchase coefficients (RPCs) for Blue Earth County. The RPCs are the percentage of demand for the inputs shown which are available from within the county. For example, the farrow-finish operations reported that 100% of their complete feed is produced within the county. In contrast, the finishing units reported that they only purchased between 21 and 56 percent of their complete feeds from firms within the county.

The regional purchase coefficients were estimated using data from a survey of 132 pork producers in Blue Earth, Martin, Murray, and Pipestone Counties. Of the 272 producers contacted, 132 or 48.5% responded. Another 7.7 percent were found to have quit raising hogs. Three separate mailings were used to secure this excellent response rate. The initial mailing resulted in a 28% response. The postcard sent two weeks after the first mailing resulted in another 5.5% and the second complete survey sent four weeks after the initial one resulted in another 15% of the respondents. Of the 132, 111 of the questionnaires were usable. These came from Blue Earth (36), Martin (35), Murray (21), and Pipestone (19).

The population was from a list of pork producers that belong to the Minnesota Pork Producers Association. Data was available on the size of operation that allowed us to sub-divide the population by size. We elected to sample 100% of the large producers due to the small number. For the smaller sizes, a random sample of 60 units was taken for each county except Pipestone where 100% of the small units were sampled.

The questionnaire listed the major inputs and services required for a swine operation. The focus was on inputs and services that might reasonably be purchased either in or outside of their home county. We omitted services for which there is not much of a choice, such as electric utilities. The producers were asked to indicate the county in state in which each input or service was commonly purchased. To estimate the regional purchase coefficients, we simply added the number of responses where the input or service was purchased in the home county. To arrive at a percentage purchased in-county for that input and operation type/size, we divided that total by the total number of responses (in-county plus outside-county) for that question. The mail survey format forced us to keep the questionnaire short and simple, so we were not able to ask for a lot of detail, such as whether they purchased a given input in more than one location and the percentage split between locations. Such limitations on the makeup of the questions introduce a certain unavoidable degree of approximation in the coefficients.

Table 7. In-county purchase coefficients for key inputs by operation type, size, Blue Earth County, 1999

Input category	IMPLAN industry	Swine Operation Type and Size			
		Farrow-finish		Finish	
		Under 1,000 sows	1,000 or more sows	Under 5,000 finished	5,000 or more finished
		(percent)	(percent)	(percent)	(percent)
No. Observations		15	5	11	5
Gilts		0.0224	0.0000		
Boars		0.0000	0.6279		
Artificial Insemination		0.0000	0.1264		
Complete Feeds		1.0000	1.0000	0.5615	0.2100
Premixes		0.2440	0.1395	0.5173	0.0000
Veterinarian		0.1710	0.1134	0.4017	0.0000
Health Supplies		0.0814	0.8866	0.6642	1.0000
Transport		0.1113	0.7732	0.3289	0.3478
Financial Records		0.3484	0.7442	0.8266	1.0000
Accounting		0.3646	0.3750	0.0000	0.0000
Depreciation		0.9009	0.2856	0.9578	0.5206
Excavation and Concrete		0.9061	0.0589	1.0000	0.8974
Framing Structure		0.8902	0.2802	1.0000	0.3238
Roofing, Walls and Exterior		1.0000	0.3673	1.0000	0.4053
Feeding, Manure Handling Equipment		0.9027	0.1197	1.0000	0.7538
Heating and Ventilation Equipment		0.7917	0.0607	0.7753	0.6376
Other building components		0.5928	1.0000	0.7873	0.6912
Labor		0.8865	1.0000	1.0000	1.0000

Source: Platas, 2000

Table 8. In-county purchase coefficients for key inputs by operation type, size, Martin County

	Swine Operation Type and Size			
Input category	Farrow-finish		Finish	
	Under 1,000 sows	1,000 or more sows	Under 5,000 finished	5,000 or more finished
No. Observations	12	9	8	6
Gilts	0.6568	0.3329		
Boars	0.2038	0.0732		
Artificial Insemination	0.5789	0.6664		
Complete Feeds	1.0000	0.0608	0.6619	0.1839
Premixes	0.4846	0.5673	-	0.4571
Veterinarian	1.0000	0.7998	1.0000	0.6856
Health Supplies	0.6887	0.1515	1.0000	0.4203
Transport	0.9177	0.6346	0.7546	0.7333
Financial Records	1.0000	0.6497	0.3923	1.0000
Accounting	0.7185	0.6000	-	1.0000
Depreciation	0.6783	0.2562	1.0000	0.5915
Excavation and Concrete	0.9116	0.1936	1.0000	0.2305
Framing Structure	0.4425	0.0223	1.0000	0.7582
Roofing, Walls and Exterior	0.2435	0.3482	1.0000	0.1911
Feeding, Manure Handling Equipment	1.0000	0.6088	1.0000	1.0000
Heating and Ventilation Equipment	0.9555	0.3336	1.0000	1.0000
Other building components	0.5836	0.2653	1.0000	1.0000
Labor	1.0000	0.3513	1.0000	1.0000

Table 9. In-county purchase coefficients for key inputs by operation type, size, Murray County

	Swine Operation Type and Size	
Input category	Farrow-finish	Finish
	Under 1,000 finished	Under 5,000 finished
No. Observations	16	5
Gilts	-	
Boars	0.0655	
Artificial Insemination	-	
Complete Feeds	0.4794	0.6471
Premixes	0.7341	0.8378
Veterinarian	0.4383	0.6047
Health Supplies	0.7182	0.4545
Transport	0.6977	1.0000
Financial Records	0.3268	1.0000
Accounting	-	1.0000
Depreciation	0.2335	0.2836
Excavation and Concrete	0.6302	0.0904
Framing Structure	0.8854	0.4611
Roofing, Walls and Exterior	0.6478	0.3671
Feeding, Manure Handling Equipment	0.1487	0.0382
Heating and Ventilation Equipment	0.3450	0.4166
Other building components	0.8754	0.6780
Labor	1.0000	1.0000

Table 10. In-county purchase coefficients for key inputs by operation type, size, Pipestone County

	Swine Operation Type and Size			
Input category	Farrow-finish		Finish	
	Under 5,000 finished	5,000 or more finished	Under 5,000 finished	5,000 or more finished
No. Observations	6	6	4	3
Gilts	0.5333	0.7660		
Boars	0.3168	-		
Artificial Insemination	1.0000	1.0000		
Complete Feeds	0.4001	0.3184	1.0000	0.3012
Premixes	0.2136	-	0.5313	0.1445
Veterinarian	1.0000	1.0000	1.0000	1.0000
Health Supplies	-	0.5455	1.0000	-
Transport	0.5979	0.9330	1.0000	1.0000
Financial Records	0.5476	0.2327	0.6000	0.6647
Accounting	1.0000	1.0000	-	1.0000
Depreciation	0.6362	0.9163	0.7706	0.3041
Excavation and Concrete	0.4205	0.9755	1.0000	0.8582
Framing Structure	0.6813	0.9056	1.0000	0.0620
Roofing, Walls and Exterior	0.6180	0.8804	1.0000	0.0620
Feeding, Manure Handling Equipment	0.5522	0.8762	-	0.6250
Heating and Ventilation Equipment	0.7872	0.7999	-	0.1429
Other building components	1.0000	0.8678	1.0000	1.0000
Labor	0.7917	0.9560	-	-

While there are good reasons to expect large producers to buy a smaller percentage of their inputs locally, our survey results show that this is often not the case. For the farrow-finish operations, the small operations had higher RPCs only 48% of the time. For another 37% of the inputs, the large farrow-finish had higher RPCs and for 15 percent the RPCs were identical between the two sizes.

For the finishing operations, the results were similar. For only 53% of the inputs did the small operations have higher RPCs than the large ones. In 36 percent of the cases the RPCs were identical and for 11 percent of the inputs, the larger operations has higher RPCs than the small operations.

Generally, the finishing operations had higher RPCs than the farrow-finish operations. However, given the differences in size and type of operation these are difficult to compare.

Table 11. In-state purchase coefficients for key inputs, weighted average of all operation types and sizes, Minnesota, 1999

Input category	Regional Purchase Coefficient
Replacement boars and gilts	0.8807
Complete feeds	0.9881
Veterinarian	1.0000
Premixes	0.8927
Health supplies	0.9173
Financial records	0.8831
Accounting	0.9868
Depreciation	0.7948
Excavation and concrete	0.9985
Framing structures	0.6953
Feeding, manure handling equipment	0.9245
Heating and ventilation equipment	0.8530
Transport	1.0000
Roofing, walls and exterior	0.7541
Other building components	0.6667

Does it matter if the RPCs are lower than 1.00 in the county? Yes, it does for the county level impacts. But it is possible that most of the purchases that leak outside the county stay within the state. If this is the case then county RPCs that are below 1.00 do not matter as far as the state's economy goes. The loses to one county within the state are the gains of another. Table 11 presents the RPCs for the state rather than individual counties. This shows that except for construction supplies (framing structures, roofing, walls, and exterior, and other building components) and depreciation, over 85% of the inputs used by pork producers are produced within the state. For example, 98.8 percent of the complete feeds are produced within Minnesota, while 89.27 percent of the premixes are produced within the state.

Another aspect of the economic impacts of different sizes of operation is the average annual salary of hired workers. While total economic activity and employment might be high, if the average wages are low, this suggests low quality of jobs. Table 12 reports on the average salaries of hired workers in Minnesota swine operations in 1999. As shown in Table 12, farrow-to-finish workers average about 35 percent more than the finishing operation workers. Within the farrow-to-finish operations, workers in the large units earned nearly 32 percent more than those in the smaller ones. Likewise, within the finishing units, the workers in the larger units earned slightly over 7 percent more than in the small to medium sized units.

Table 12. Salaries of Hired Workers in Minnesota Swine Operations, 1999 Average

Operation type	Labor Productivity (hours/head finished)	Annual salary ($)
Farrow-to-finish, less than 5,000 finished	1.25	21,143
Farrow-to-finish, 5,000 or more finished	0.97	27,857
Finishing, under 2,500 finished	1.13	17,631
Finishing, 2,500 - 4,999 finished	1.01	17,632
Finishing, 5,000 or more finished	0.8	18,928

Source: Terry Hurley, Department of Applied Economics, University of Minnesota, from unpublished data from an early 2000 national survey of pork producers.

VII. Local Government Revenue and Expenditure Impacts

The second objective of this research was to estimate the changes in local government expenditures and revenues due to economic changes stemming from the pork industry.

The local government revenue and expenditure impacts of sixteen different scenarios were estimated using the Minnesota Regional Integrated Modeling System (MNRIMS). This modeling system was originally developed for Minnesota by Inhyuck Ha (1999). The MNRIMS adjusts the IMPLAN input-output estimates of labor impacts for labor commuting and unemployment using an econometric module. Then it has econometric models for estimating the changes in population, student enrollment, property taxes, and other local government revenues and expenditures.[v]

Table 13 shows the results under same two assumptions as for the economic impact comparison in Table 5 above. The top panel shows the results assuming both the small and large farms produce at a $40 million level. The bottom panel is adjusted for the projected reduced survival rate of the small farms. At the same production level, the small farms generate greater net impacts in every case except for the farrow-finish scenario in Pipestone County. When the small farm scenarios' volume is reduced by a third (to $26.4 million), the large operations had more positive local government impacts than the small ones in every county. Remember that these estimates control for the total output within a county so it is only the type and size of operation that is different.

While additional work needs to be done to accurately compare the fiscal impacts of different sizes of operations, it appears that nearly all sizes and types of operations are likely to yield tax benefits to state and local governments.

[v] For a detailed discussion of this see the 225 page Ph.D thesis by Inhyuck Ha, "The Minnesota Regional Integrated Modeling System: A Case Study of Economic and Fiscal Impacts of Tax Abatements", Department of Applied Economics, University of Minnesota, 1999. While Ha studied a different issue, his model can be used for any economic shock.

Table 13. Net State and Local Government Fiscal Impacts of $40 Million in Swine Production by Size and Type of Operation in Selected Minnesota Counties, 1999

County	Operation Type/Size	Revenue ($000)	Expenditures ($000)	Net Impacts ($000)
	Assumes all sizes and types of firms continue to operate over the next five years			
Blue Earth	Farrow-Finish small[a]	$1,036	$903	$133
	Farrow-finish big[b]	1,063	927	136
	Finish small[c]	995	868	127
	Finish big[d]	787	686	101
Martin	Farrow-Finish small	927	811	117
	Farrow-finish big	853	746	107
	Finish small	708	618	89
	Finish big	681	595	86
Murray	Farrow-Finish small	727	636	91
	Finish small	515	452	64
Pipestone	Farrow-Finish small	836	732	105
	Farrow-finish big	875	766	109
	Finish small	752	658	94
	Finish big	713	624	89
	Assumes large operations continue to operate over the next five years But that only 66% of the small ones continue in operation			
Blue Earth	Farrow-Finish small[a]	$684	$596	$88
	Farrow-finish big[b]	1,063	927	136
	Finish small[c]	657	573	84
	Finish big[d]	787	686	101
Martin	Farrow-Finish small	612	535	77
	Farrow-finish big	853	746	107
	Finish small	467	408	59
	Finish big	681	595	86
Murray	Farrow-Finish small	480	420	60
	Finish small	340	298	42
Pipestone	Farrow-Finish small	552	483	69
	Farrow-finish big	875	766	109
	Finish small	496	434	62
	Finish big	713	624	89

**Minnesota Regional Integrated Modeling System

[a]Farrow to finish operations with less than 5000 head finished/year

[b]Farrow to finish operations with more than 5000 head finished/year

[c]Finishing operations with less than 5000 head finished/year

[d]Finishing operations with more than 5000 head finished/year

Source: Platas, 2000

VIII. Comparison of Changes in Corn Utilization and Prices

One of the most important economic benefits of the pork industry is the market that it provides for the state's crop production. As the swine and dairy industries have consolidated, a number of new, large facilities have been constructed in some counties. Older, usually smaller operations have discontinued production across the state, so that the geographic location of feed utilization has changed to some degree. A number of ethanol plants have gone into production in recent years. These also add to the utilization of crops, mostly corn. The cattle feeding, poultry, and sheep industries are other feed utilizers.

This analysis focuses on corn utilization shifts and associated changes in local elevator corn prices between 1993 and 1998. The location of soybean meal consumption is probably also changing in much the same way as for corn, but local soybean prices are less likely to be affected because soybean processing is concentrated in the Mankato area. Regardless of where the soybean meal is consumed, soybean prices are likely to be related to the cost of transportation to Mankato. Local elevator corn prices are available in a collection of DTN printouts accumulated in the Department of Applied Economics starting in March, 1993, so the comparison was done with that time frame as a baseline. The most recent year for which data was available was 1998, so that year was used for comparison.

8.1 Changes in Corn Utilization by County

Corn utilization in 1993 and 1998 is compared with corn production harvested in the state in the previous years, 1992 and 1997. The 741 million bushel 1992 crop was average in size, just one percent above trend (Figure 2). Utilization in late 1993 may also have been influenced by the short 1993 crop, which was less than half of trend levels at 322 bushels because of the extremely wet growing conditions that year. The 1997 crop was larger at 851 million bushels, which was six percent over trend and was followed by an even larger crop in 1998.

The diversity of conditions under which livestock is produced makes it difficult to estimate overall corn utilization with much certainty. The approach used was to start with USDA National Agricultural Statistics county data on livestock and poultry inventories and production numbers. Corn consumption per animal for cattle, hogs, and sheep was taken from the 1996 farm business record summaries of the Southwestern and Southeastern Minnesota Farm Business Management Associations (FBMA), and the 1996 Minnesota State College University System's Farm Business Management Education Program (MnSCU). University of Minnesota extension poultry scientist Sally Noll provided estimates of typical poultry corn consumption. Staff at the Minnesota Department of Agriculture provided data on ethanol plant capacities.

The only geographical shift in poultry production considered in the analysis is the start-up of the two million bird Golden Oval egg laying operation, which began operations in Olivia near the end of 1994 and reached full production by late 1996. Poultry data is only

published by NASS at the state level for turkeys and broilers, and for each of the nine within-state reporting regions for egg production. County-level poultry numbers were based on 1992 Census of Agriculture county data and verified by Minnesota Turkey Growers Association and Minnesota Broiler and Egg Association staff, who felt that the geographical location of production had not changed much over the four years with the exception of Golden Oval. The county poultry numbers were scaled proportionately to the changes in the state and regional totals from 1993 to 1997.

Table 14 shows the state total inventories and production for the species and age categories considered. The biggest increase was in the inventory of all hogs, which was up 17 percent. Turkey inventories increased by six percent between 1993 and 1998, while layers increased by 12 percent over the period. Broiler production decreased. Swine inventories and the pig crop increased, while cattle decreased. The biggest decrease was in sheep inventories, which went down 41 percent.

Figure 1. Corn Production in Minnesota, 1980-98

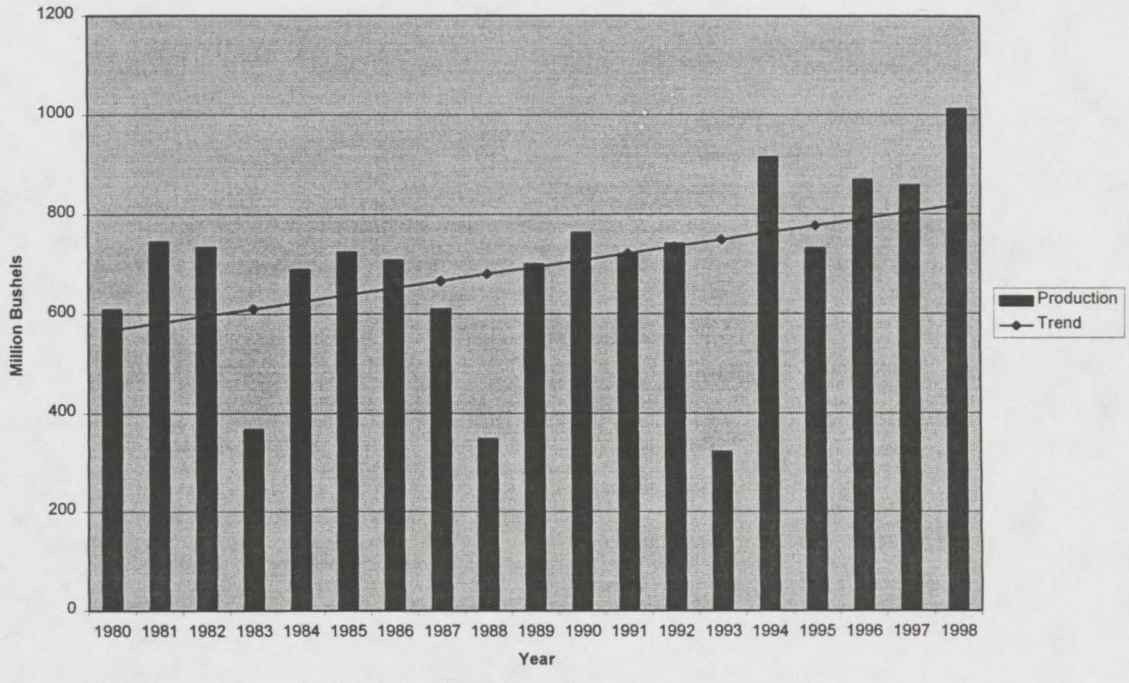


Figure 2. Corn Production in Minnesota, 1990-99.

Table 14. Livestock and Poultry Inventories and Production in Minnesota, 1993 and 1998

Species	Type of data	1993	1998	Change
All cattle	Inventory, January 1	2,849,300	2,599,600	-9%
Beef cows	Inventory, January 1	409,700	399,700	-2%
Milk cows	Inventory, January 1	660,000	570,000	-14%
Cattle on feed	Inventory, January 1	329,900	275,000	-17%
All hogs and pigs	Inventory, previous December 1	4,700,000	5,500,000	17%
Pigs saved (pig crop)	Total production, Dec. - Nov.	8,618,000	8,829,000	2%
All sheep	Inventory, January 1	184,900	109,900	-41%
Turkeys raised	Total production, Jan. - Dec.	42,000,000	44,500,000	6%
Commercial broilers raised	Total production, Dec. - Nov.	46,600,000	42,300,000	-9%
Annual average layers	Inventory, annual average	10,731,000	12,032,000	12%

Source: USDA Minnesota Agricultural Statistics Service, Minnesota Agricultural Statistics, 1994 and 1999

A number of feeds and ingredient categories are detailed separately in the farm business summary data, including:

a) corn,
b) protein, vitamins, and minerals, and
c) complete ration.

Total corn consumption per unit was estimated for each enterprise by adding a percentage of the complete ration to the amount of corn fed separately. The complete ration was assumed to have the same percentage of corn as the in the total of corn and protein supplement fed separately.

Ethanol production will utilize a significant share of the corn crop if the plants in the state operate at stated capacity. The 1993 corn consumption estimates include the MCP plant at Marshall and the Morris plant (Table 15). By 1998, there were eight more plants in the state, six of which utilize corn. Another plant at Preston opened in August 1998, but is not included in the corn utilization figures shown in Tables 16-18.

Table 15. Plant capacity for ethanol, starch and sweeteners has increased over the four years,

Plant location	Plant name	County	Ethanol Capacity	Corn Utilization	Start-up year
			(mill. gallons/year)	(mill. bu./year)	
Included in 1993 utilization					
Marshall	MCP	Lyon	32	58.4[a]	1988
Morris	Morris Ag Energy	Stevens	8	3.0	1991
Total 1993			40	61.4	
Included in 1998 utilization, in addition to MCP and Morris					
Winnebago	Corn Plus	Faribault	19	7.2	1994
Winthrop	Heartland	Sibley	14	5.3	1995
Benson	CVAC	Swift	19	7.2	1996
Claremont	Al-Corn	Dodge	14	5.3	1996
Bingham Lake	E-2000	Cottonwood	14	5.3	1997
Buffalo Lake	MN Energy	Renville	11	4.2	1997
Melrose	Kraft	Stearns	1.5	(cheese whey)	1986
Dundas	MN Clean Fuels	Rice	0.5	(wheat gluten)	1992
Total 1998			133	95.9	
Preston	Procorn	Fillmore	19	7.1	Aug. 1998
Total 1999			152	103.0	

Source: MN Department of Agriculture

[a]The MCP number includes 12.8 million bushels of corn for ethanol and 48 million bushels for starch, sweeteners and gluten feeds.

Table 16 shows how the utilization of the corn crop varies by NASS region. Slightly over half of the state's corn crop was apparently exported in 1998. The region exporting the largest share of its crop is the west central region. Cattle and sheep consume the largest share of the crop in every region except south central, where swine predominates, and the southwest where ethanol and sweeteners are the largest use. Corn utilization by the pork industry increased significantly (52 percent) in the south central region. There was also a smaller increase in the southwest. Swine's corn utilization declined in the central part of the state and stayed constant in the southeast. Utilization by cattle and sheep declined across the state.

Some assumptions were made to match up the NASS species and business summary enterprise categories. Feedlot regulations frequently make reference to animal units as a measure of livestock operation size and potential for odor and environmental problems. Therefore, each of the categories in Table 16 were also related to an animal unit measure in order to calculate total animal units as another way to evaluate changes in the state's livestock and poultry industries (see Table 17). The animal unit equivalent numbers are only a rough indication of manure production (and feed consumption), and the species vary in proportion of their diet the corn comprises. So, it is not surprising that corn consumed per animal unit varies by species. Corn consumed varies from about 50 to 150 bushels per year per animal unit inventory, with the exception of beef cows whose diet is almost entirely forage and very little of corn and other grains.

Table 16 and Figures 3 and 4 show changes in estimated corn utilization and exports out of the state between the two years. Utilization increased by 11 percent, but this increase is dwarfed by the 15 increase in the size of the crop so that 19 percent more was likely exported in 1998. The utilization numbers most likely relate to corn coming out of storage while the production numbers are going into storage, so there are probably some storage losses included in the exports which are calculated as the difference between production and in-state utilization.

County-level corn utilization patterns are compared in Figures 5 through 7. In order to adjust for differences in county size, total corn utilization by county was divided by total harvested cropland numbers from the 1992 Census of Agriculture to arrive at the numbers shown in the two maps. The three maps also contain "topographic elevation" lines at five bushel intervals and are color-coded using an inverse-distance-weighted interpolation technique built into two computerized mapping programs, MAPINFO Professional version 5.0 and Vertical Mapper[vi]. The interpolation technique associates each county number with the centroid of the county. These points, one per county, are then used to interpolate values for a grid covering the rest of the map. The map is divided into a 300 x 291 cell grid, with a grid node size which was set at 0.0267 degrees or approximately 1.2 miles in an east-west direction and 1.8 miles north-south. Vertical Mapper then searches for data points within a search radius of 1.33 degrees or approximately 60 miles east-west and 90 miles north-south, considering a minimum of one and a maximum of 25 data points. The data points are weighted based on the inverse of their distance to the grid node.

[vi] Mapinfo and Vertical Mapper are marketed by Mapinfo Corporation, Troy, NY, www.mapinfo.com.

The comparison shows a shift in overall corn utilization southward in the state between 1993 and 1997, with the biggest change being a 41% increase in the south central region due to increased hog numbers and ethanol plant capacity. Two counties that saw large increases were Faribault County, which saw an increase from 12 to 30 bushels per cropland acre, and Sibley which rose from 25 to 40. Cottonwood and Dodge were other counties with significant increases. Utilization stayed relatively constant in the northern third of the state.

Table 16. Corn Utilization by Species or Use and Region in Minnesota, 1993 and 1998

	Prior Year Production	Cattle & Sheep	Hogs	Poultry	Ethanol	Total In-State Utilization	Exports (Residual)	Total Utilization
1993				(million bushels)				
Central	135.41	42.45	16.98	26.04	-	85.48	49.93	135.41
East Central	16.00	10.28	1.76	1.21	-	13.25	2.75	16.00
North Central	0.76	3.49	0.59	0.05	-	4.13	(3.36)	0.76
Northwest	5.35	10.12	1.64	2.78	-	14.54	(9.19)	5.35
South Central	207.23	15.83	32.26	5.07	-	53.15	154.08	207.23
Southeast	104.58	29.28	13.93	1.53	-	44.74	59.84	104.58
Southwest	161.22	20.19	24.91	2.22	58.40	105.72	55.50	161.22
West Central	110.41	19.72	11.12	1.66	3.00	35.50	74.91	110.41
Minnesota	740.95	151.36	103.18	40.56	61.40	356.49	384.46	740.95
1998								
Central	153.23	39.36	15.55	28.64	9.50	93.05	60.18	153.23
East Central	21.03	8.54	1.49	1.24	-	11.27	9.76	21.03
North Central	1.87	3.07	0.32	0.05	-	3.44	(1.57)	1.87
Northwest	12.61	8.69	1.10	3.17	-	12.96	(0.35)	12.61
South Central	217.85	13.60	49.08	4.89	7.20	74.77	143.08	217.85
Southeast	136.13	26.66	13.89	1.45	5.30	47.30	88.83	136.13
Southwest	162.76	17.91	27.67	2.11	63.70	111.39	51.37	162.76
West Central	145.78	16.84	10.66	1.80	10.20	39.50	106.27	145.78
Minnesota	851.26	134.67	119.75	43.36	95.90	393.69	457.57	851.26
Percent Change, 1993 - 97								
Central	13%	-7%	-8%	10%		9%	21%	13%
East Central	31%	-17%	-16%	3%		-15%	255%	31%
North Central	146%	-12%	-45%	-6%		-17%	-53%	146%
Northwest	136%	-14%	-33%	14%		-11%	-96%	136%
South Central	5%	-14%	52%	-3%		41%	-7%	5%
Southeast	30%	-9%	0%	-5%		6%	48%	30%
Southwest	1%	-11%	11%	-5%	9%	5%	-7%	1%
West Central	32%	-15%	-4%	9%	240%	11%	42%	32%
Minnesota	15%	-11%	16%	7%	56%	10%	19%	15%

Source: Production is from USDA National Agricultural Statistics Service. Livestock utilization was estimated from USDA-NASS livestock numbers and livestock per-unit consumption figures from Minnesota Farm Business Management Association enterprise summaries. Poultry per unit consumption numbers are from Sally Noll, U of MN extension poultry scientist.

Table 17. Corn Utilization by Livestock and Poultry in Minnesota, 1993 and 1998, and Associated Animal Units

	Corn Utilization					Animal Units			
	1993		1998		Change	1993	1998	Change	Corn bu./AU, 1998
	(mill. bu.)		(mill. bu.)			(million)	(million)		
Total production, previous year	741		851		15%				
Utilization									
Cattle and Sheep	151	20%	135	16%	-11%	3.28	2.99	-9%	45
Swine	103	14%	120	14%	16%	1.47	1.71	16%	70
Poultry	41	5%	43	5%	6%	0.37	0.39	5%	112
Ethanol and sweetener plants	61	8%	96	11%	57%				
Total utilization	356	47%	394	46%	11%	5.13	5.08	-1%	77
Exports out of state (and storage losses)	385	53%	458	54%	19%	0.00	0.00		
Total utilization	741	100%	851	100%					

Source: Animal unit equivalents per head are taken from Running Your Feedlot For Farm Economy and Water Resource Protection, by the Minnesota Pollution Control Agency (undated).

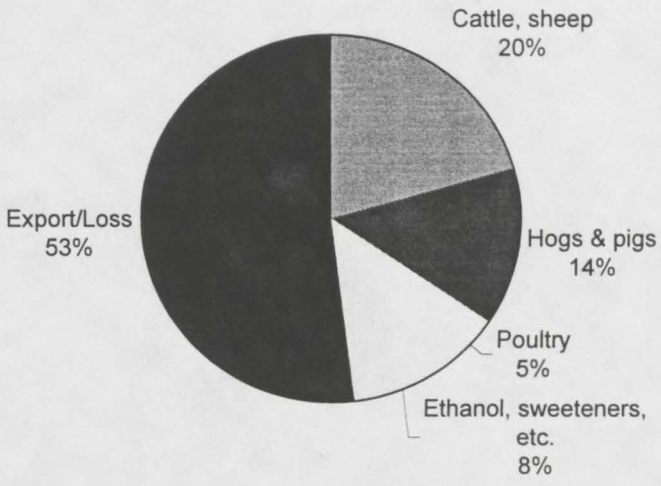


Figure 3. Utilization of 1992's 741 Million Bushel Corn Crop

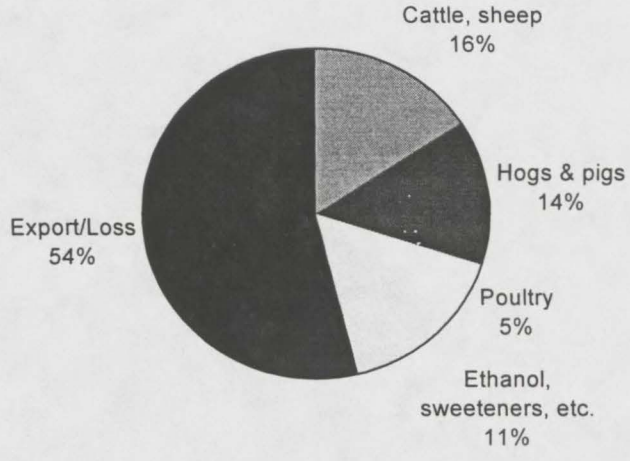


Figure 4. Utilization of 1997's 851 Million Bushel Corn Crop

On a regional basis, total corn utilization is greatest in the southwestern region. All three southern regions and the central and west central regions showed increases, while the three northern ones and the east central region declined (Table 18).

8.2 Changes in Local Elevator Corn Prices

With half of the corn crop being exported out of the state in both years, local grain prices are not expected to respond at all to increased local utilization.

> "This situation occurs because, at the margin, the export market always sets the price, and if local prices rise above the export price, no exports will occur. This is true because local elevators pay all producers the same price for grain, regardless of whether that grain is fed locally or exported. Elevators in grain-surplus regions will therefore offer a single price to all farmers that allows the elevators to profitably sell on export markets. This price will essentially equal the Gulf price less the cost of transporting grain to the Gulf."[vii]

On the other hand, ethanol plants and livestock expansions have been justified on the basis of corn price increases in at least the immediate local area. To test the hypothesis that increased local utilization has an impact on local corn prices, the geographical pattern of DTN local elevator corn prices was compared for two dates, March 10, 1993 and February 23, 1999. Prices were available for 94 locations on the earlier date, and averaged $1.90 per bushel. The prices averaged $1.75 by the later date, when 135 locations were reported on. Seventy-six of the locations were reported for both dates. The numbers of locations by agricultural statistics region are shown in Tables 19 and 20. The table also shows how the price changed from the earlier date to the later one, after adjusting for the difference in the overall state average price.

One striking feature of Table 19 is that the price differential at Newport, on the river in the East Central Region, was 10 cents higher in 1998 than earlier. Away from the river, the differential was also slightly higher in the south central region and the southeast. The differential decreased in the other regions.

It is time-consuming to do the type of comparison shown in Table 19, but two other dates were also examined to evaluate how much fluctuation there is from year to year. Price differentials compared to the state averages were also calculated for December 17, 1993 and March 1, 1998. The changes in the differentials were then compared across three time intervals:

a) 3/10/93 - 12/17/93,
b) 12/17/93 - 3/1/98, and
c) 3/1/98 - 2/23/99.

Over the first interval, from March to December 1993, the differential at Newport in the east central region increased by 10 cents, and increased another 12 cents by March 1998. The second 12-cent increase reversed itself by February 1999. The differentials in the south central and southeastern regions were also high in 1998 and backed off in 1999. The northwestern region saw an increase in late 1993 which reversed itself by 1998. Changes were not as dramatic in the

[vii] Dermot Hayes, Daniel Otto, and John Lawrence. "Pork Industry in Iowa: An Industry at a Crossroads." in 1996 Pork Industry Economic Review, National Pork Producers Council, page 142.

other regions. The "cumulative change" column in Table 20 should be equal to the changes shown in Table 19 except that for changes in the mix of elevators reporting, since the two intervals are the same. The changes were the same or nearly the same in every region except for the northwest, where the seven elevators reporting in both 1993 and 1999 showed a five-cent decrease while those reporting over the three shorter intervals showed a three-cent increase. The two-cent decrease on the line marked "Minnesota" shows that the locations included (which are only the locations reporting on both dates) apparently were paying slighly lower prices on the later date relative to other locations not included (because they did not report on one date or the other)

The corn prices were linked with geographic data files by matching city and township names. The city and township points were then used to interpolate estimated prices for all other points in the spaces between local elevators. Then, color-coded maps of the state were drawn to show changes over time in utilization and prices, using Mapinfo and Vertical Mapper. The numbers shown on Figures 8 through 11 represent the price differences between each location and the state average for that date. The "topographic elevation" lines are at five cent intervals.

8.3 Conclusions from the Comparison of Corn Utilization and Prices

The main conclusion from the corn price comparison is that while the location of utilization has shifted somewhat toward the southern part of the state, the price differential has so far only changed in response by a few cents per bushel. This is consistent with what Hayes et al. expected to happen, as quoted above. The year-to-year changes are likely to be swamped by seasonal shifts within a particular year.

Table 18. Corn Utilization by Region in Minnesota, Total and Per Harvested Cropland Acre, 1993 and 1998, Bushels

	Total		Cropland	Per Acre		Change	
Region	1993	1998	Acres	1993	1998	Percent	Per Acre
Northwest	14,538,153	12,957,329	4,334,929	3.35	2.99	-11%	-0.36
North Central	3,498,860	3,442,154	290,834	12.03	11.84	-2%	-0.19
West Central	35,496,707	39,504,264	3,910,392	9.08	10.10	11%	1.02
Central	85,477,693	93,049,709	3,444,336	24.82	27.02	9%	2.20
East Central	13,247,529	11,270,825	899,884	14.72	12.52	-15%	-2.20
Southwest	105,718,105	111,388,848	2,970,655	35.59	37.50	5%	1.91
South Central	53,153,230	74,774,380	3,064,017	17.35	24.40	41%	7.06
Southeast	44,736,340	47,299,599	2,220,474	20.15	21.30	6%	1.15
Minnesota	356,494,166	393,687,108	21,135,521	16.87	18.63	10%	1.76

Source: Acres are total harvested cropland acres from the 1992 Census of Agriculture.

Table 19. Number of Local Elevator Locations with Prices Reported on Both March 10, 1993 and February 23, 1999, and Change in Price Differential Relative to State Average Price on Each Date.

Region	Change in Utilization	Number of Locations with Prices on Both Dates	Change in Price Differential Relative to State Average
	(bushels/acre)		(cents/bushel)
Northwest	-0.36	7	-5
West Central	1.02	21	-4
Central	2.20	12	-3
East Central	-2.20	(Newport) 1	10
Southwest	1.91	14	-2
South Central	7.06	16	2
Southeast	1.15	5	1
Minnesota	1.76	76	-2

Source: Price differentials from state averages were calculated from local elevator prices reported by DTN.

Table 20. Pairwise Comparison of Local Elevator Locations with Prices Reported on Four Dates, and Change in Price Differential Relative to State Average Price on Each Date.

	3/10/93 to 12/17/93	12/17/93 to 3/1/98	3/1/98 to 2/23/99	
		Locations		
NW	6	5	8	
WC	20	23	33	
C	15	15	23	
EC	1	1	1	
SW	15	14	22	
SC	15	17	19	
SE	6	5	10	
Minnesota	78	80	116	
	Change in Price Differential From Earlier Date to Later Date			Cumulative Change
NW	11	-10	2	3
WC	-4	-3	3	-4
C	-4	4	-2	-2
EC	10	12	-12	10
SW	-4	-1	0	-4
SC	-5	9	-2	2
SE	-4	9	-4	0
Minnesota	-3	2	0	-1

Source: Price differentials from state averages were calculated from local elevator prices reported by DTN.

Figure 5. Corn Consumption per Cropland Acre, 1993

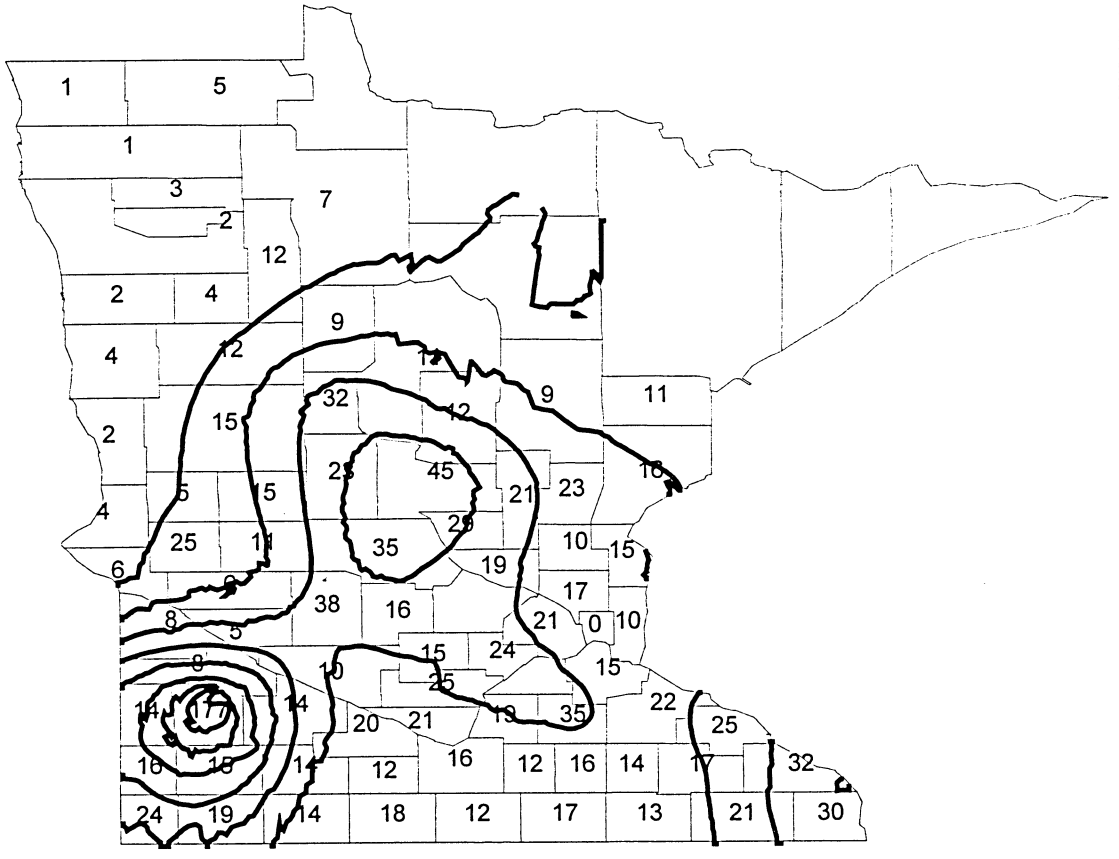


Figure 6. Corn Consumption per Cropland Acre, 1997

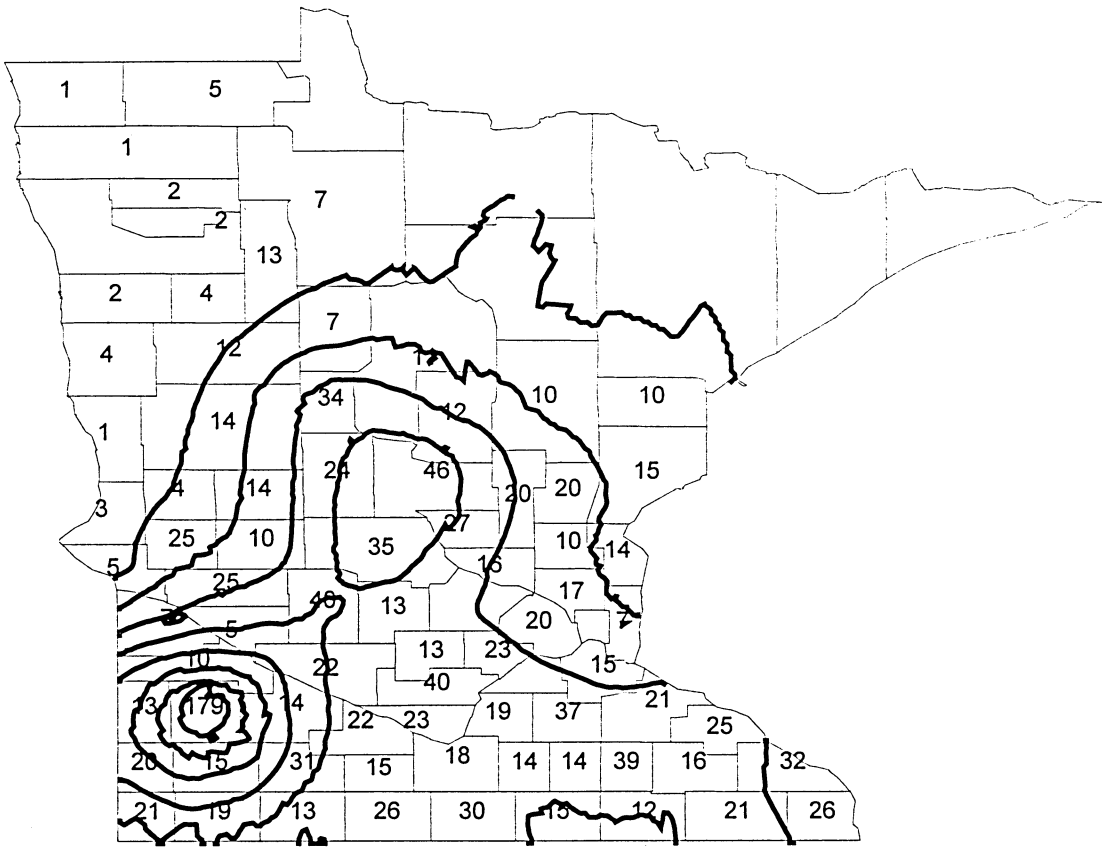


Figure 7. Corn Consumption per Cropland Acre, 1998

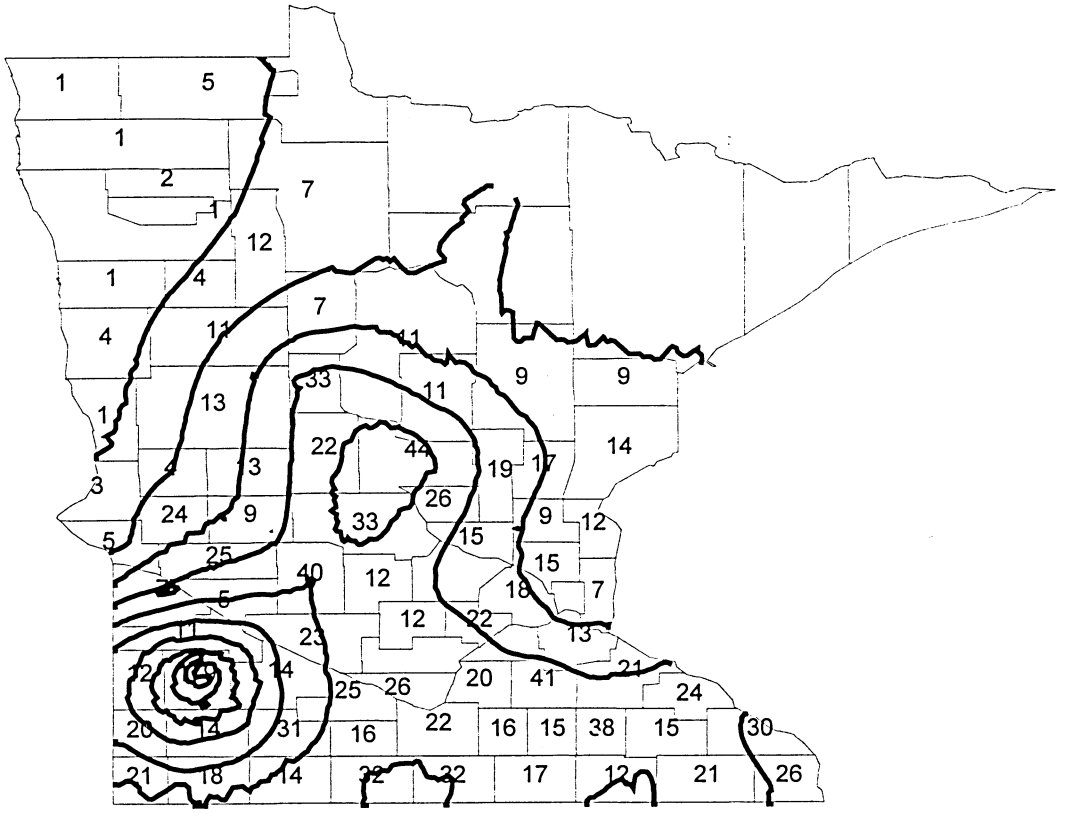


Figure 8. Corn Price Deviations from State Average, March 10, 1993

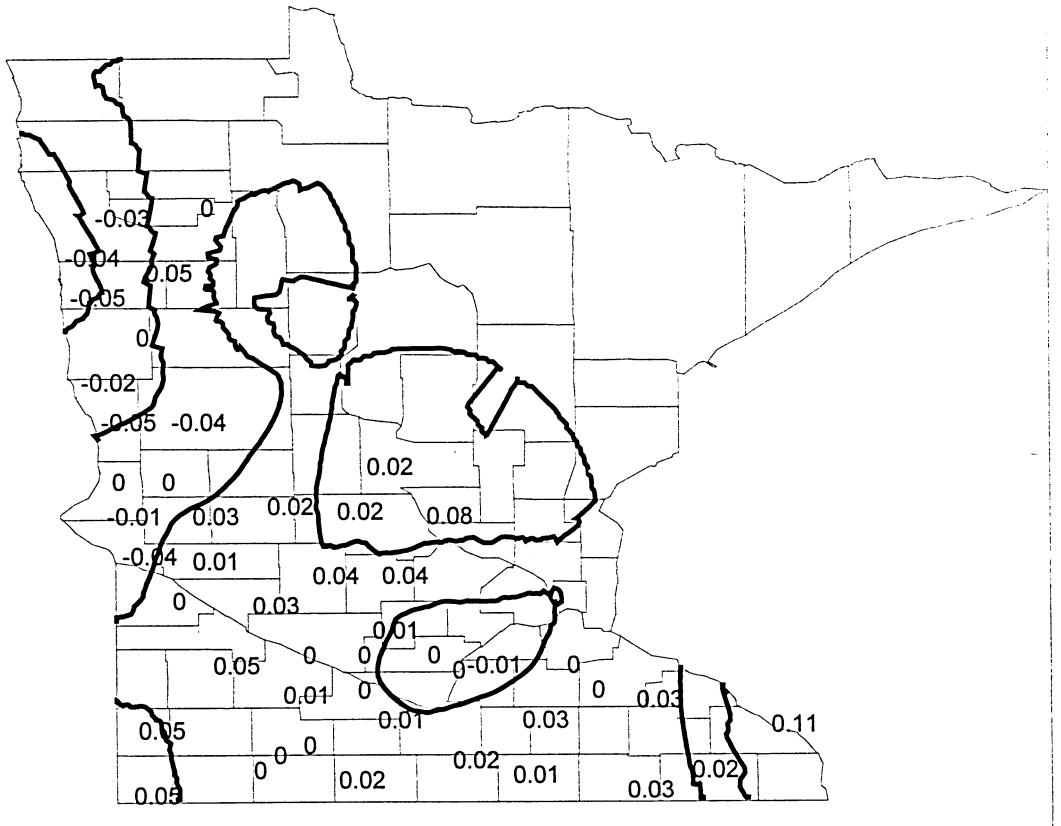


Figure 9. Corn Price Deviations from State Average, 12/20/93

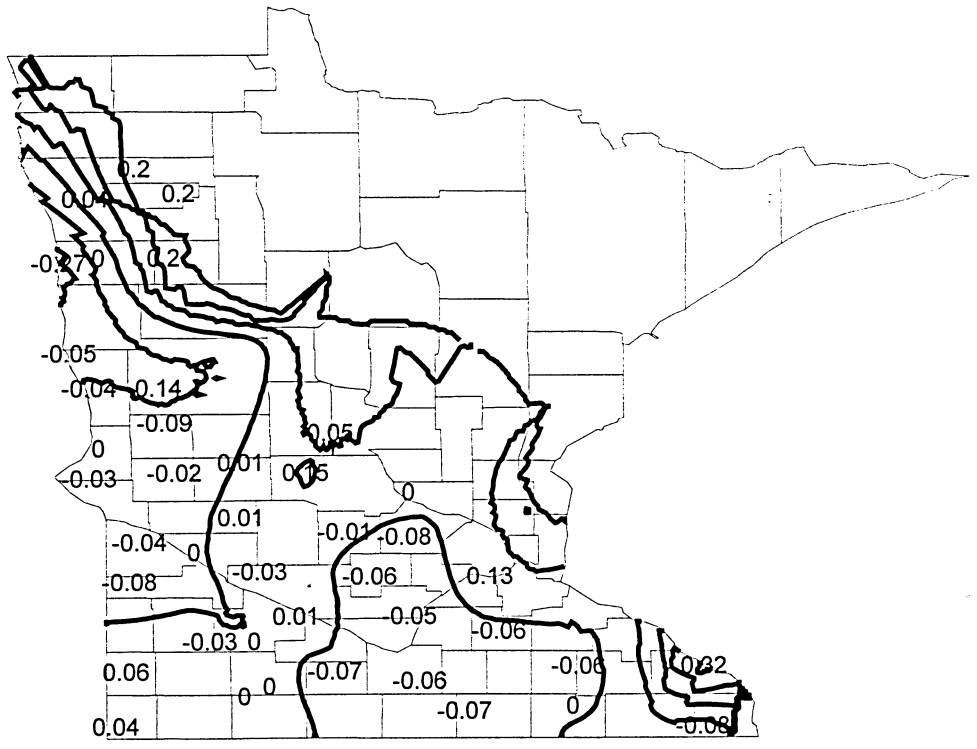


Figure 10. Corn Price Deviations from State Average, March 1, 1998

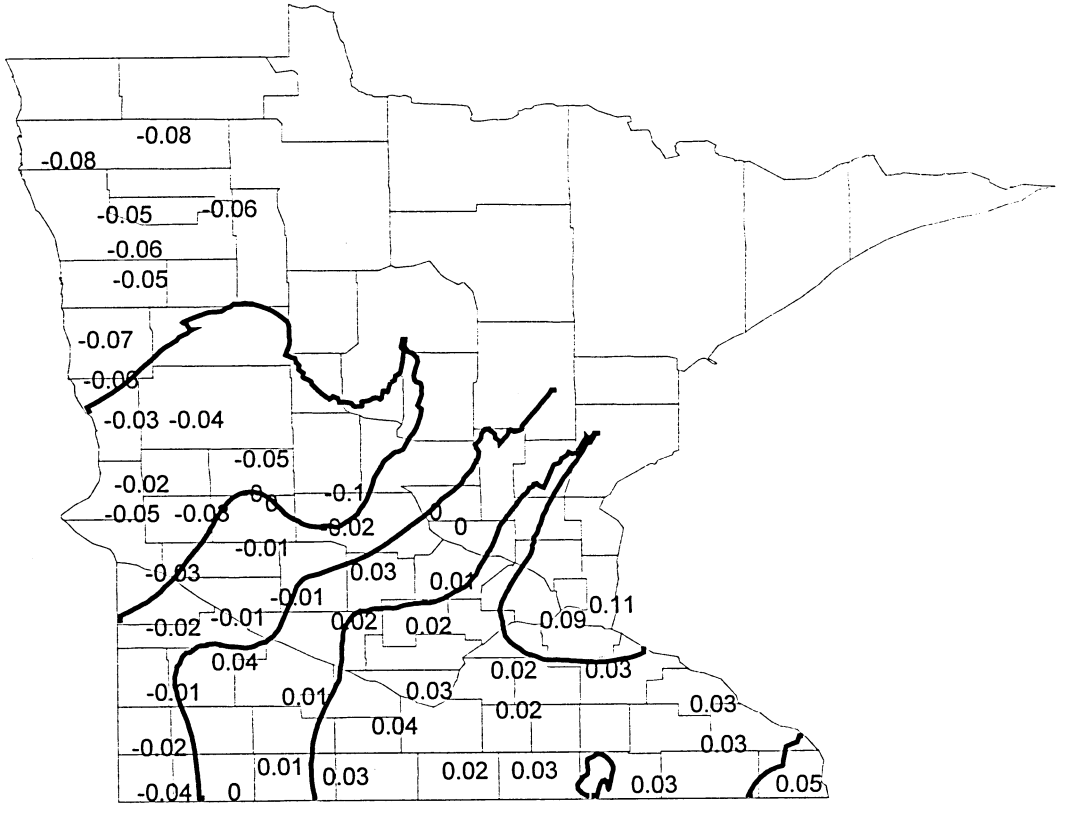


Figure 11. Corn Price Deviations from State Average, February 23, 1999

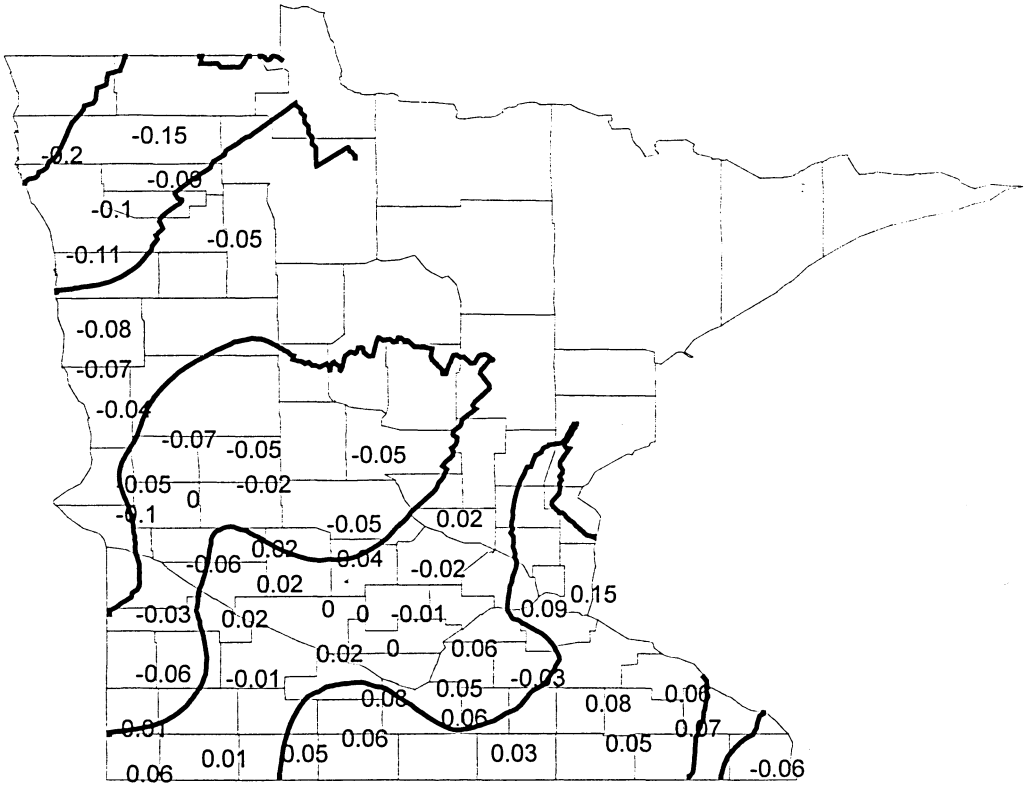
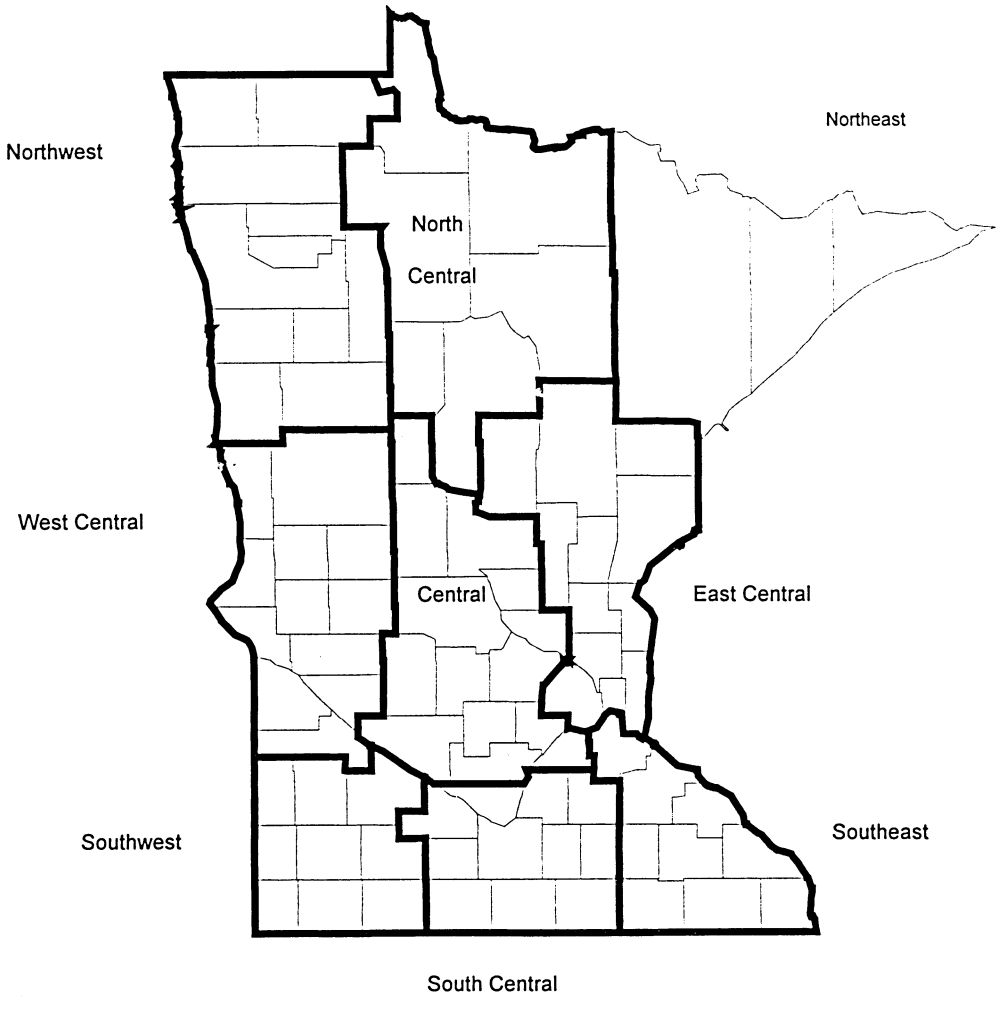


Figure 12. USDA-NASS Agricultural Statistics Reporting Regions



IX. Summary and Conclusions

The overall objective of this research project was to evaluate the economic and local government impacts of the pork industry and recent changes in the industry. Specifically, we estimated the private sector economic impacts and local government impacts of the pork industry on employment and income both within the pork industry and in supply industries which depend on the pork industry. We focused on whether there are differences in the impacts of large and small scale operations. Third, we examined the year-to-year changes in local corn price patterns around Minnesota to see if changes correlated with changes in the location of pork production and other utilization. In summary, this research incorporates the following new approaches to estimating the regional economic impacts of pork production.

While the economic and fiscal impacts of pork production had been studied in earlier research projects, all of these have been criticized as having one or more weaknesses. In this project we tried to avoid those problems by incorporating seven innovations into the research methodology. Specifically, we made the following improvements in the impact estimates:

1) farm management data from Minnesota was used in place of national or regional data for the pork farm expenditure or production functions;
2) the production functions were specific to two different types of systems (farrow-to-finish versus farrowing and finishing at separate locations) rather than a single production function for all hog operations;
3) within each type of operation, different production functions were used for two different sizes of operation;
4) labor requirements were estimated for each of the four pork production scenarios outlined above from Minnesota farm management data and the IMPLAN model adjusted to reflect these;
5) wages for hired labor were derived from preliminary results from the National Pork Producers Council's year 2000 national survey and incorporated into the four scenarios used in the IMPLAN model;
6) a survey of over 130 hog producers was used to examine the purchasing patterns for the four different types and sizes of operation with the regional purchase coefficients entered into the IMPLAN model; and
7) survival rates for the different types and sizes of operation were considered as a means of developing long-term estimates of the impacts.

The major innovation in this study was the survey of producers to collect primary data on the location of their purchases. Over 270 producers in four different counties were sent mail surveys and we had a response rate of 48 percent. The data allowed us to estimate the regional purchase coefficients for each of the major inputs at both the county level and the state level. While there was substantial variation in the percent of inputs purchased within a county (Murray County being the lowest and Martin having the highest), there also was a lot of variation among inputs. However, when examined at the state level, nearly all inputs were purchased in-state except for construction materials.

This study found that at the state level, the pork industry accounted for $2.2 billion in total output within farms and processing and $4.1 billion when counting the total effects. Nearly 9,000 jobs were in pork farms and processing plants with another 19,000 dependent on the pork industry.

The evidence on competitiveness by size of operation is mixed. Yet, the historical trend of size of operation clearly indicates that the number of smaller operations is declining while the number of large operations is increasing. Consequently, we used the historical trends to adjust the results for long-term estimates.

The empirical results show that the impacts of similar types and sizes of units do vary depending on the county in which they are located. However, the variation is relatively limited. Wages and proprietor incomes appear to vary more between counties than employment. This reflects the differences in local economic structures rather than differences in the pork industry. The overall picture when the results are adjusted for survival the employment impacts vary less by only 10 percent or less across types and sizes of operations and across counties. This suggests that from a regional economic impact prospective, it does not really matter which type or size of operation is in the county. While the smaller operations have higher employment impacts without the survival adjustment, they are less likely to be there in the long-run so the employment impacts tend to net out about the same. On the other hand, the income impacts tend to favor the larger operations. This reflects the higher wages paid in the larger operations.

The main conclusion from the corn price comparison is that while the location of utilization has shifted somewhat toward the southern part of the state, the price differential has so far only changed in response by a few cents per bushel. The year-to-year changes are likely to be swamped by seasonal shifts within a particular year.

Appendix - Questionnaire Used in Mail Survey of Local Input Purchase Patterns

U of MN or MPPA letterhead)
(Date)

(each producer's name and address from mail merge)

Dear (name):

The economic impact of the Minnesota swine industry is of great interest to the public, the state and local communities as they consider permitting and other policy issues. The Minnesota Pork Producers Association has asked the University of Minnesota to update estimates of how our industry affects the rest of the state's economy. This information will be very useful in helping the public understand the importance of our sector.

Please complete the questionnaire that is enclosed with this letter, and return it in the self-addressed, stamped envelope: The survey should take about 5 to 10 minutes to complete. If you are uncertain about a question, please provide your best estimate. To help us develop a solid picture of the industry, it is important that you complete the entire survey.

You may assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. Your name will never be placed on the questionnaire. Results will only be reported as averages and percentages so no data will be available on individual producers.

If you would like a copy of the report when it is completed write your name on the back of the return envelope. We will be happy to answer any follow-up question you may have about the results. Questions can be addressed to Bill Lazarus at the University of Minnesota, by phone at (612) 625-8150 or by e-mail at wlazarus@extension.umn.edu

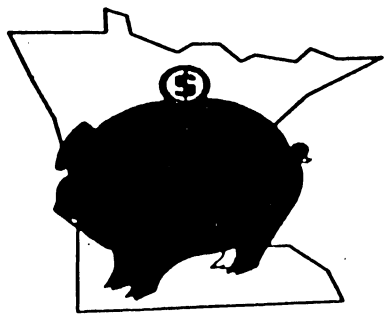
Thank you in advance for your cooperation.

Sincerely yours.

Dr. William F. Lazarus
Associate Professor
University of Minnesota

Mr. David Preisler
Executive Director
Minnesota Pork ProducersAssociation

Economic Impact of The Minnesota Pork Industry



Most of the impact that you as pork producer have on the economy has to do with where you purchase your inputs and hire the services that you use. So, we are asking a small group of producers to complete a short questionnaire which will help us to assess the economic importance of the swine industry. Please complete for the units your operate.

Please return your complete questionnaire in the enclosed envelope to:

Dr. William F. Lazarus
Department of Applied Economics
Classroom Office Building, 1994 Buford Avenue
University of Minnesota
St. Paul, Minnesota 55108
(612)625-8150

Q1. Do you have a sow herd? (circle one)

NO → GO TO Q8

YES → (NUMBER OF SOWS ON 12/1/98_____)

Q2. For your sow herd, do you purchase complete sow feed or do you process your own corn into sow feed on the farm? (circle one)

1 I PURCHASE COMPLETE FEED FOR THE SOW HERD

2 I PROCESS MY OWN FEED FOR THE SOW HERD

Q3. Do you purchase your own replacement gilts for breeding, or keep back your own replacements? (circle one)

1 KEEP BACK MY OWN GILTS → GO TO Q5

2 PURCHASE REPLACEMENT GILTS

Q4. Where are the replacement gilts you purchase farrowed?

_____ COUNTY _____ STATE

Q5. Where are the boars you purchase farrowed?

_____ COUNTY _____ STATE

Q6. Where does your veterinarian have his/her office?

_____ COUNTY _____STATE

Economic Impact of
The Minnesota Pork Industry

Most of the impact that you as pork producer have on the economy has to do with where you purchase your inputs and hire the services that you use. So, we are asking a small group of producers to complete a short questionnaire which will help us to assess the economic importance of the swine industry. Please complete for the units your operate.

Please return your complete questionnaire in the enclosed envelope to:

Dr. William F. Lazarus
Department of Applied Economics
Classroom Office Building, 1994 Buford Avenue
University of Minnesota
St. Paul, Minnesota 55108
(612)625-8150

Q1. Do you have a sow herd? (circle one)

NO → GO TO Q8

YES → (NUMBER OF SOWS ON 12/1/98_____)

Q2. For your sow herd, do you purchase complete sow feed or do you process your own corn into sow feed on the farm? (circle one)

1 I PURCHASE COMPLETE FEED FOR THE SOW HERD

2 I PROCESS MY OWN FEED FOR THE SOW HERD

Q3. Do you purchase your own replacement gilts for breeding, or keep back your own replacements? (circle one)

1 KEEP BACK MY OWN GILTS → GO TO Q5

2 PURCHASE REPLACEMENT GILTS

Q4. Where are the replacement gilts you purchase farrowed?

_____ COUNTY _____ STATE

Q5. Where are the boars you purchase farrowed?

_____ COUNTY _____ STATE

Q6. Where does your veterinarian have his/her office?

_____ COUNTY _____ STATE

Q7. Do you use artificial insemination in your herd using purchased boar semen?

1 NO → GO TO Q8

2 YES → WHERE IS THE BOAR STUD YOU USE?

_____ COUNTY _____ STATE

Q8. Do you have a grow/finish operation? (circle one)

1 NO → GO TO Q12

2 YES → (NUMBER OF HEAD FINISHED IN 1998_____)

Q9. Do you purchase complete feeds for the grow/finish operation, or do you process your own corn into grow/finish feed on the farm? (circle one)

1 I PURCHASE COMPLETE FEED FOR THE GROW/FINISH OPERATION

2 I PROCESS MY OWN FEED FOR THE GROW/FINISH OPERATION

Q10. If you purchase any complete feeds, where is the feed mill located where most of your feed is processed?

_____ COUNTY _____ STATE

Q11. If you process any of your own feed, where are most of your premixes delivered from?

_____ COUNTY _____ STATE

Q12. Do you swine health supplies from suppliers other than your eterinarian? (circle one)

1 NO → GO TO Q13

2 YES → WHERE DO YOU PURCHASE YOUR SWINE HEALTH SUPPLIES?

_____ COUNTY _____ STATE

Q13. Where is the trucker based who does most of the trucking of your hogs to market?

_____ COUNTY _____STATE

Q14. Do you belong to a farm business management association, utilize a farm management instructor, or pay someone else to assist you with financial records, analysis and tax preparation? (circle one)

1 NO → GO TO Q14

2 YES → WHERE IS THAT PERSON'S OFFICE?

_____ COUNTY _____ STATE

Q15. Do you pay someone to process the swine production records for your operation? (for example, PICHAMP or PIGTALES) (circle one)

1 NO

2 YES → WHERE IS THAT PERSON'S OFFICE?

_____ COUNTY _____ STATE

Q16. In which county are your operation located?

_____ COUNTY

Q17. Have you built any new swine buildings on your operation in the past five years (1994 or later)?

1 NO → GO TO Q20

2 YES →

Q18. What was the value of the new construction?

$_____ Year?_____

Q19. Of this amount, how much was for each of the following types of goods and services? In which county was the supplier was based ?

	% OF TOTAL VALUE	COUNTY	STATE
Earthmoving and onsite concrete work			
Lumber for framing the structrure			
Labor for erection of the structure and installaing			
Prefabricated slats and other flooring			
Roofing and exterior siding			
Prefabricated wall panels			
Crates and gating			
Feeding equiment			
Heating and Ventilation equipment			
Manure handling equipment labor			
Other components			
Total	100%		

Q20. Is there anything else you would like to talk us about the economic impacts of the Minnesota swine industry?

ID # _____

Your contribution to this effort is greatly appreciated. If you would like a summary of results, please print your name and address on the back of the return envelope. (Not on this questionnaire)

List of References Cited

Barrows, R. 1993. Public policy education: key concepts and methods. Madison, WI: University of Wisconsin, North Central Regional Extension, October (publishing state).

Chism, JW. 1993. Local spending patterns of farm businesses in Southwest Minnesota. St. Paul, MN: University of Minnesota, Department of Agricultural and Applied Economics (Master's Plan B paper (M.S.)).

Chism, JW, Levins, RA. 1994. Farm spending and local selling: how do they match up? St. Paul, MN: University of Minnesota, Minnesota Extension Service; University of Minnesota, Department of Agricultural and Applied Economics. Minnesota Agricultural Economist 676:1-4.

DeLind, LB. 1998. Parma: a story of hog hotels and local resistance. In: Thu, KM, Durrenberger, EP, editors. Pigs, profits, and rural communities. Albany, NY: State University of New York Press p 23-38.

DiPietre, D, Watson, C. 1994. The economic effect of premium standard farms in Missouri. Columbia, MO: University Extension, Commercial Agriculture Program, CA 144, University of Missouri.

Foster, Kenneth, Chris Hurt, and Jeffrey Hale. "Comparison of Production Systems," in *Positioning Your Pork Operation for the 21st Century.* West Lafayette, IN: Purdue Cooperative Extension Service, 1995.

Goldschmidt, W. 1978. As you sow: three studies in the social consequences of agribusiness. Montclair, NJ: Allanheld, Osmun and Co. Publishers, Inc.

Ha, I. The Minnesota Regional Integrated Modeling System: A Case Study of the Economic and Fiscal Impacts of Tax Abatements, Ph.D. Thesis, Department of Applied Economics, University of Minnesota, 1999.

Ha, I, Morse, GW. 1998. Economic and fiscal impacts of property tax abatements: a regional integrated modeling system approach. Paper presented at the 45th North American meetings of the Regional Science Association International 1998 in Santa Fe, NM, November.

Hasting S.E., Bruker S.M. "An Introduction to Regional Input-Output Analysis." Microcomputer-Based Input-Output Modeling: Applications to Economic Development. Otto D.M., Johnson T.G. eds., Boulder:Westview Press, 1993.

Hurley, Terry. Department of Applied Economics, University of Minnesota (personal communication, March 2000).

Hurt, Chris, Keith Good, and Ken Foster. *Comparing Costs of Hog Production in the Midwest*

With Large Integrated North Carolina Systems (Unpublished Mimeo). W. Lafayette, IN: Purdue University, 1995.

Ikerd, JE. 1998. Sustainable agriculture, rural economic development, and large-scale swine production. In: Thu, KM, Durrenberger, EP, editors. Pigs, profits, and rural communities. Albany, NY: State University of New York Press p 157-169.

Jahae, IAMA,van Staalduinen, L. 1992. Application of input-output methodology for local community impact analysis: swine production in Redwood County, Minnesota. St. Paul, MN: University of Minnesota, Department of Agricultural and Applied Economics, Staff Paper P92-12.

Lasley, P. 1995. Economic development. In: Thu, K., editor. Understanding the impacts of large-scale swine production: proceedings from an interdisciplinary scientific workshop, June 29-30, 1995, Des Moines, Iowa. Des Moines, IA: North Central Regional Center for Rural Development. p 117-151.

Lawrence, John, Glenn Grimes, and Marvin Hayenga. "Production and Marketing Characteristics of U.S. Pork Producers, 1997-1998, Staff paper 311." Web page, undated [accessed 23 April 1999]. Available at http://www.econ.iastate.edu/faculty/lawrence/staffppr331.pdf#Staff paper 311.

Lazarus, W.F. and B.L. Buhr. Minnesota Pork Industry Review, bulletin published by the Minnesota Pork Producers Association, June 1994.

Leistritz, FL, Sell, R. 1993. Economic impact of expanding swine production in North Dakota. Fargo, ND: North Dakota State University, Department of Agricultural Economics, AE93007—No. 02 Regional Model Analysis, Value-Added Agriculture Project, NDSU.

Lobao, LM. 1990. Locality and inequality: farm and industry structure and socioeconomic conditions. Albany, NY: State University of New York Press.

Lobao, L, Schulman, MD. 1991. Farming patterns, rural restructuring, and poverty: a comparative regional analysis. Rural Sociology 56(4):565-602.

McKissick, JC, Turner, SC, Kriesel, WP, Luke, A, Cato, T. 1998. Feasibility analysis for a proposed pork processing plant in Alma, Georgia. Athens, GA: The University of Georgia, College of Agricultural and Environmental Sciences, Department of Agricultural and Applied Economics (AGECON-98-046).

Miller, RE, Blair, PD. 1985. Input-output analysis: foundations and extensions. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Olson and Lindall, 1996. IMPLAN Professional, Social Accounting & Impact Analysis Software. Manual. Implan Group. Stillwater, Minnesota.

Otto, DM. 1995. The impact of pork production on Iowa's economy. In: The Iowa pork industry in transition—local decisions in a global marketplace. Ames, IA: Iowa State University, Department of Economics. p 13-18.

Otto, D, Orazem, P, Huffman, W. 1998. Community and economic impacts of the Iowa hog industry. In: Iowa's pork industry—dollars and scents. Ames, IA: Iowa State University, Department of Economics. p 25-28.

Otto, D, Lawrence J, Swenson, D. 1996. Local economic impacts of hog production. Pork Industries Economic Review:27-38.

Otto, DM, Johnson, TG, editors. 1993. Microcomputer-based input-output modeling: applications to economic development. Boulder, CO: Westview Press, Inc.

Platas, Diego. Economic and Fiscal Impacts of Different Sizes Of Swine Operations on Minnesota Counties. Ph.D. Thesis, Department of Applied Economics, University of Minnesota. (Forthcoming in April 2000).

Phillips, C., G.Morse, S.Guess-Murphy, P. Welle, "A Summary of the Literature Related to the External Benefits and Costs," in Generic Environmental Impact Statement on Animal Agricultural (edited by B. Durgan and K. Draeger), Prepared for the Environmental Quality Board and on Minnesota Planning web page, 1999.

Ralston, DN, Hastings, SE, Rucker, SM. 1985. Improving regional I-O models: evidence against uniform regional purchase coefficients across rows. Journal of Regional Science, November:65-80.

Serecon Management Consulting Inc. 1998. Socio-economic impact of hog operations in Alberta. Prepared for Alberta Pork Producers Development Corporation and Alberta Agriculture, Food and Rural Development. Edmonton, Alberta.

Shields, M. 1998. An integrated economic impact and simulation model for Wisconsin counties. Unpublished Ph.D. dissertation, University of Wisconsin, Madison.

Stevens, B., Treyz G., and Lahr M. "On the Comparative Accuracy of RPC Estimating Techniques." In Frontiers of Input-Output Analysis, edited by Miller R., Polenske K., and Rose A. New York, Oxford University Press. 1989.

Thompson, N, Haskins, L. 1998. Searching for "sound science:" a critique of three university studies on the economic impacts of large-scale hog operations. Walthill, NE: Center for Rural Affairs.

Thornsbury, SD, Kambhampaty, SM, Kenyon, D. 1993. Economic impact of a swine complex in Southside Virginia. Blacksburg, VA: Virginia Cooperative Extension.

Warner, L, Plaxico, JS. The Oklahoma pork industry: an economic impact analysis. Prepared for the Oklahoma Pork Producers.